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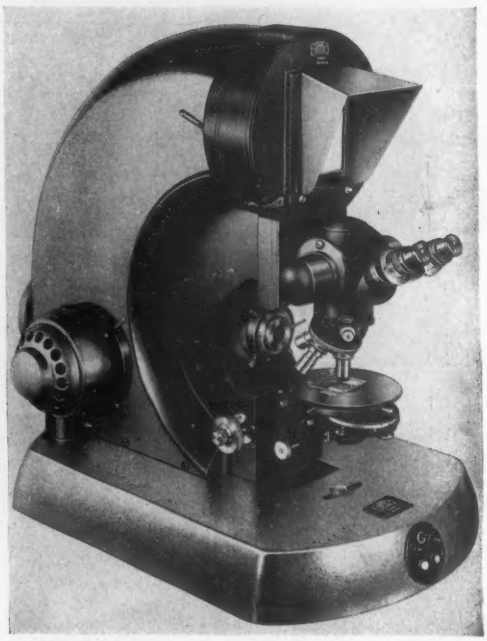

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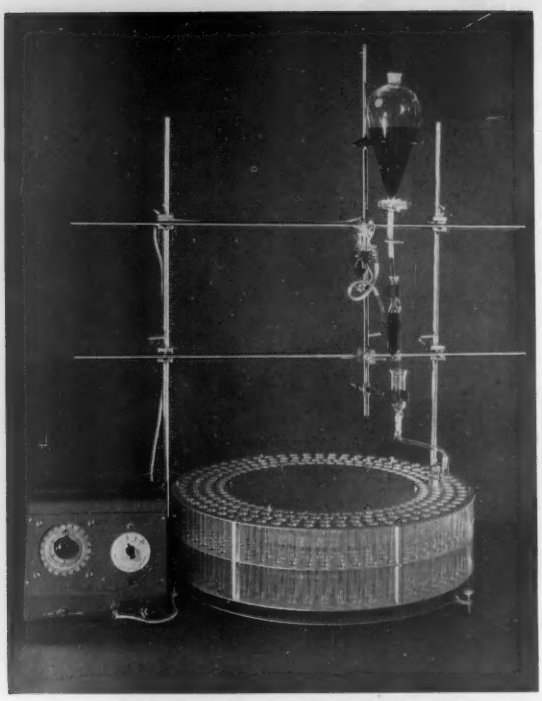

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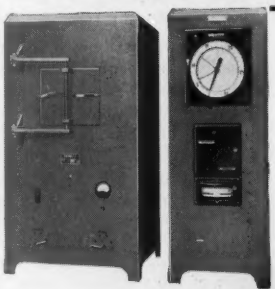

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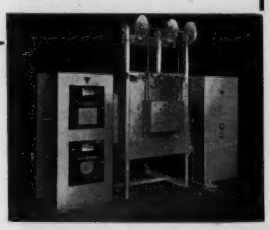

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Is There a Scientific Method?

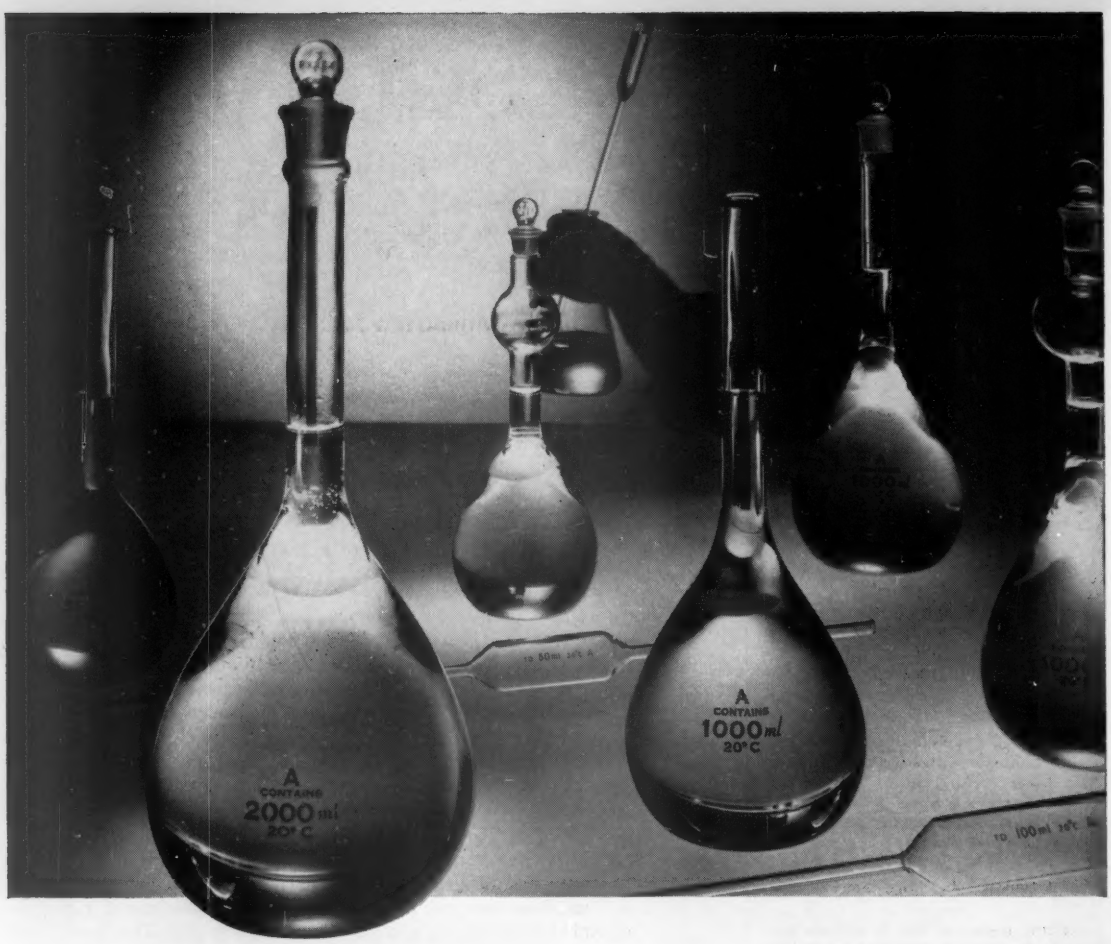
The question of whether there is a scientific method produces a game that any number can play. If philosophers—with a knowledge of science limited for the most part to the finished product—can speak of a method, or even *the* method, then scientists—with firsthand experience in groping for new scientific ideas—can speak of as many methods as there are problems or even deny that in discovery there is such a thing as method at all. Yet, perhaps, a careful answer to the question would reveal that, despite differences in interest and emphasis, all the players are on the same side.

In broadest outline, science has as its purpose the discovery of true generalizations or laws of nature, these generalizations being used to explain particular happenings. For example, you explain the bursting of a particular water pipe in a particular house during a particular winter in terms of the severity of that winter and the generalization that water always expands on freezing. Or you explain the occurrence of a particular eclipse in terms of earlier positions and velocities of the planets and Newton's law of universal gravitation.

Method enters science in the business of how you go about increasing the probability that a given generalization is true. If you merely reel off a greater and greater number of positive instances, then you are using the wrong method. The unity underlying all inquiries is that to turn the trick you must seek other kinds of instances as well. Thus, to increase the probability that all A's are B's, you must not only examine joint occurrences of A and B but must seek out circumstances in which at least A is not present and circumstances in which at least B is not present. The classic, if not altogether complete, formulation of method in this sense was given by the 19th-century philosopher John Stuart Mill in his five canons of inductive inference.

An illustration in miniature of scientific method is Edward Whymper's explanation of the curious evaporation that invariably holds in the high Alps. Whymper, who is better known as the first man to scale the Matterhorn, would awake in the morning to discover that a considerable quantity of wine had disappeared from his flask during the night. Since the Chamonix porters in his party always vigorously denied having seen anyone touch the flask, there seemed no explanation of the event other than the unusual dryness of the high mountain air. But Whymper, by examining a circumstance in which, so to speak, neither A nor B was present, found a way to increase the probability of the truth of his suspicions, and, incidentally, to save his wine. He showed that the evaporation ceased completely when he used the flask as a pillow during the night.

In this illustration, there is reference to an underlying method, but there is no claim to an automatic procedure for solving problems. Of course, given a set of variables, A, B, C, and D, you can examine mechanically all possible combinations in a search for invariable relationships. But, to decide in the first place what variables are relevant to the problem requires an insight for which no rules are available.—J. T.



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Undergraduate Origins of American Scientists

John L. Holland

The role of undergraduate institutions in the production of scientists and scholars is ambiguous, despite two comprehensive studies by Knapp *et al.* (*1*, *2*). These studies suggest that certain colleges and universities are more productive of scientists and scholars than others—a kind of "institutional productivity" hypothesis. The results of the present study, however, argue for an opposed hypothesis, or a "student quality and motivation" hypothesis; namely, differential institutional productivity appears to be a function of the concentration of bright students at certain institutions and of differences in student motivation for scientific and scholarly achievement. Specifically, bright students congregate in institutions with high indices of scientific productivity; their explanations for their choice of college seem consistent with a need for scientific achievement, and they have fathers whose choice of occupation appears conducive to intellectual achievement. In contrast, bright students attend institutions with low indices of productivity in fewer numbers; they give explanations for their college choice which are suggestive of a more external or practical orientation to education, and they have fathers whose occupations suggest a fostering of persuasive or leadership skills and achievement.

The first study of this problem, by Knapp and Goodrich (*1*), implies that certain colleges and universities are more productive than others of men who are later listed in *American Men of Science*. The 50 colleges in this group, for the period 1924–34, are characterized by their small size, liberal arts orientation, and geographic location—Middle and Far West. In a second investigation, Knapp and Greenbaum studied the undergraduate origins of promising young scholars (*2*). For this study, the criterion of productivity is the number of graduate fellowships and scholarships and of Ph.D. degrees awarded per institution in proportion to the total number of their graduates for the period 1946–51. Taken together, these analyses imply that the scientist who has achieved distinction and his younger counterpart, the promising scholar in science as well as in other fields, originate the most frequently in two select sets of 50 colleges and universities and that the special qualities of these institutions facilitate achievement in science or scholarship in general.

The present study reexamines the "institutional productivity" hypothesis in the light of some new evidence obtained in the course of the National Merit Scholarship program. This scholastic talent search yielded several national samples of scholastically superior high-school seniors, with sufficient background data to explore three fundamental questions concerning institutional productivity. (i) Are differential rates of college productivity a function of differential attendance rates by scholastically superior students? (ii) Are differential rates of college productivity a function of student socioeconomic status? (iii) Are differential rates of productivity a function of paternal vocational motivation and the implied attitudes and values concerning science, scholarship, and achievement?

Basic Data

The high-school senior samples studied in the following sections include four similar groups obtained in the National Merit Scholarship program for the years 1955 and 1956: (i) The winners in the 1955 program, 556 National Merit Scholars; (ii) a 10-percent sample of the Certificate of Merit students, or 430 near winners for 1955; (iii) a 73-percent sample, or 3000, of the 4226 Certificate of Merit winners who replied to a questionnaire concerning present college attendance and scholarships (this sample overlaps sample ii); and (iv) a 10-percent sample of the 7500 finalists for 1957, or 750 Merit Scholars and Certificate of Merit students. Groups i, ii, and iii represent the survivors of a nation-wide testing program. All students ranked at least in the top 5 percent of their graduating class. Their average verbal and mathematical aptitude scores place them in about the top 2 percent of the graduating high-school population. Group iv represents a sample of the survivors of the 1956 program, in which 162,000 high-school seniors participated. The average scholastic ability score for this sample places them in about the top 5 percent of the high-school graduating population. Within these samples, more than 71 percent of each male sample have chosen a scientific career. The concentration in science for females is about 35 percent. More explicit descriptions of these populations are provided in several other reports (*3*).

All four samples are biased, since school participation in this program varies from state to state (22 to 80 percent) and since urban and larger schools participate more frequently than rural and smaller schools. No exact estimates of bias exist, but census estimates suggest that about 88 percent of the 1955 senior population did participate (*4*). The sampling for the 1956 program is indeterminate with respect to scholastic ability, since students could be nominated by their principal or could enter the program by nominating themselves without regard to their class rank.

Results

Are differential rates of college productivity a function of differential attendance rates by scholastically superior students? A first test of this hypothesis was made by calculating the "expected" percentages of student attendance for both the Knapp and Goodrich and the Knapp and Greenbaum "high productivity" institutions. These estimates were obtained by totaling the college popula-

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tion for each of the two criterion lists of 50 colleges and determining what percentages they represent of the total undergraduate population for the United States (*5*). This simple method yielded "expected" percentages for groups of "high" and "low" productive institutions. These percentages were then compared with the "observed or actual" percentages of attendance for the Merit Scholar and Certificate of Merit samples of the 1955 program (groups i and iii). This analysis is contained in Table 1.

The data in Table 1 reveal that these talented groups attend "high" productive schools in frequencies which are 3 to 15 times the "expected" frequencies. For example, 7.3 percent of the Certificate of Merit males would be "expected" to attend the 50 Knapp and Greenbaum "high" productive colleges, and 92.7 percent would be "expected" to attend all other "low" productive colleges. Their actual attendance, however, at "high" and "low" productive colleges is 42.8 and 57.2 percent, respectively. Their actual attendance, then, at "high" productive colleges (42.8 percent) is about 6 times their expected attendance rate (7.3 percent). Similarly, their attendance at "low" productive colleges is less than their expected attendance. These results are consistent and statistically significant for both criteria. It is interesting to note that these trends hold even when the Knapp-Goodrich criterion is applied to female samples, although that criterion was devised to assess the institutional productivity of male scientists only.

It appears significant, too, that the productivity ratios for "high" productive schools approximate the ratios of students which they attract beyond their expected quotas. For the Knapp and Goodrich criterion, the median productivity ratio of "high" to "low" productive schools is about 4 to 1. High-ability students are attracted to these colleges in ratios of about 3 and 4 to 1. For the Knapp and Greenbaum criterion, the median productivity ratio of "high" to "low" productive institutions is about 4 to 1 for males and about 11 to 1 for females. The corresponding ratios of "observed attendance" of high-ability students to "expected attendance" are about 6 and 12 to 1 for males and females, respectively.

The present results are in agreement with the finding of Knapp and Goodrich (*1*), who report a correlation of 0.39 between scholastic ability and institutional indices of productivity for a sample of 50 colleges. Their limited data did not permit, however, a more complete exploration of this relationship or an estimate of the concentration of bright students in institutions with high indices.

Table 1. Percentage of expected and actual attendance of high-aptitude students at "high" and "low" productive institutions. Each 2 by 2 table is significant beyond the 0.001 level of significance.

Criterion	Males				Females			
	Cert. of Merit college attendance		Merit Scholars college attendance		Cert. of Merit college attendance		Merit Scholars college attendance	
	Expected	Observed	Expected	Observed	Expected	Observed	Expected	Observed
Knapp and Greenbaum								
High productivity	7.3	42.8	7.3	43.3	1.6	16.2	1.6	24.7
Low productivity	92.7	57.2	92.7	56.7	98.4	83.8	98.4	75.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Knapp and Goodrich								
High productivity	3.9	13.4	3.9	16.2	3.9	14.9	3.9	17.5
Low productivity	96.1	86.6	96.1	83.8	96.1	85.1	96.1	82.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

It is possible that student knowledge of the colleges' productivity indices may have a marked effect on their choice of college, so that talented students shop for colleges with high indices. Accordingly, a sample of 7500 finalists (group iv) in the 1956 National Merit Scholarship program was studied in order to explore this possible bias.

The data for this analysis were obtained from scholarship application blanks in response to the query, "Why have you selected the college named on page 1 [the student's choice]?" The students who had selected one of the 50 institutions that ranked highest in productivity in the Knapp and Goodrich study were contrasted with an equal, random sample of students who had selected other colleges and universities. The blanks were reviewed for indications that the students had any knowledge of the productivity studies that are reported here or of similar information, the implication being that such information might have influenced their choice. This search was negative.

To judge from their verbal reports, students select colleges largely from considerations of convenience, cost, familial affiliations, academic reputation, and so on. No student mentioned the productivity articles, but one of the 1628 students sampled appeared to have some secondhand knowledge of this material. It appears, therefore, that the differential attendance of high-ability students at the 50 selected institutions was not influenced by publication of the Knapp studies; an explanation of the differential rate must be sought elsewhere.

Are differential rates of institutional productivity a function of differential socioeconomic status among student populations? Since earlier work by Knapp and Goodrich (*1*) suggests that scientists may originate more frequently in "lower," rather than in "higher," socioeconomic groups and that conceivably, then, institutions with high indices of productivity may attract larger proportions of students of lower socioeconomic status, a test of this hypothesis appeared desirable.

For this test, the socioeconomic status of groups i, ii, and iv was determined by means of the Minnesota Scale for Paternal Occupations. For males, the distributions of fathers' occupations were found to be not significantly different for "high" and "low" productive institutions. For females, the differences within groups i and ii are not significant. The distributions of status for group iv—a 10-percent sample of 1956 finalists—reveal statistically significant differences. Students selecting "high" productive schools come from higher socioeconomic status than those selecting "low" productive schools. The efficiency of this discrimination is moderate. However, since five out of six tests are clearly negative, there is little evidence that differences in institutional productivity are due to different levels of socioeconomic status among student bodies.

Are differential rates of institutional productivity a function of parental vocational motivation and their implied attitudes and values concerning science, scholarship, and achievement? Restated, students attending "high" and "low" productive colleges may represent different, socially derived familial vocational motivations which might account for the differential productivity of scientists between these groups, and, by implication, "high" and "low" productive colleges may attract different kinds of people, or personalities.

Groups i, ii, and iv were employed to test this hypothesis. The fathers' occupations for these samples were classified

in one of the following six vocational interest groups: physical activity (manual and skilled trades), science, welfare or social service, clerical or business detail, persuasive or verbal activity (oral language occupations, including selling, law, and supervisory occupations), and esthetic or artistic occupations (*6*).

Distributions were then formed for institutions with high and low indices of productivity for each sample. The Knapp-Goodrich criterion was employed in this analysis, since it appears to be the more valid of the two criteria—valid in the sense that it represents an ultimate, rather than an immediate, criterion. The results of this classification for males are shown in Table 2. The results for females are clearly negative for all samples and are not reported.

Table 2 displays two meaningful trends in all three samples. Students attending or selecting "high" productive colleges tend to have fathers who are engaged in occupations characterized by their physical-activity, scientific, or social-service aspects. In contrast, students in "low" productive colleges have fathers who are engaged in occupations which are characterized by their persuasive, sales, supervisory, and leadership orientation. The differences for the "persuasive" category are statistically significant at the 0.01 level for groups i and iv and at the 0.06 level for group ii. The remaining categories are not statistically significant; however, the grouping of the physical-activity, science, and welfare occupations and of the clerical, persuasive, and esthetic categories for an over-all test is significant beyond the 0.05 level for all three samples. It should be emphasized, however, that the total difference between "high" and "low" productive samples is largely due to differences found for the "persuasive" category.

The implications of these findings are several. They suggest that the "high" and "low" productive colleges attract somewhat divergent student populations among male, high-aptitude high-school seniors. On the one hand, "high" productive colleges attract students whose fathers work with their hands (machines or tools), with scientific ideas or apparatus, or with people in a social-service sense (especially teaching). Such a background appears conducive to achievement in science or to an emphasis on intellectual attainment. In contrast, "low" productive schools attract students whose fathers' work is characterized more by its oral, persuasive, or leadership activities (in particular, supervisory and ownership positions in business, law, and government). Correspondingly, these backgrounds appear to be less fertile for the development of young scientists.

These parental vocational differences also suggest differential values and attitudes toward achievement in American society. Earlier psychometric analyses indicate that interest in science is associated with theoretical values, with a relative deemphasis on political and economic values; business interests are positively correlated with political and economic values, with a deemphasis on theoretical and scientific values. This evidence has been summarized recently by Roe (*7*).

The verbal and social quality of the "persuasive" occupations suggests another area of disparity in the backgrounds of students selecting "high" and "low" productive colleges. Studies by Stern *et al.* (*8*), Roe (*7*), and others consistently reveal that scientists as a group are less social than many other occupational groups, especially men in sales and leadership occupations. It seems reasonable to assume, then, that the children of scientists and workers would acquire somewhat similar social skills and interests and experience which, in some measure, would impel them toward achievement in relatively nonsocial pursuits. Conversely, the children of fathers who have oral and leadership skills may have their verbal and social skills fostered so that their achievement is directed toward verbal or language fields. Such a formulation implies that good business and government leaders may originate the most frequently in institutions which produce relatively few scientists, and vice versa (*9*).

This loose theorizing suggested the need for a more elaborate analysis of the college-choice evidence reviewed previously for information about productivity only; that is, student explanations of college choice for groups selecting "high" and "low" productive colleges should contain differences which are consonant with the foregoing formulations. The test of this formulation follows.

Table 2. Percentages of fathers' occupations falling in various fields of work for students selecting "high" and "low" productive institutions (males).

Field of work	Group i Merit Scholars		Group ii Cert. of Merit		Group iv Finalists	
	(No. = 65) H.P.	(No. = 337) L.P.	(No. = 47) H.P.	(No. = 261) L.P.	(No. = 76) H.P.	(No. = 449) L.P.
Physical activity	24.6	18.7	19.0	15.5	21.1	17.8
Science	16.9	12.2	21.4	15.3	15.8	12.7
Welfare	12.3	10.9	16.7	9.1	14.5	7.1‡
Clerical	12.3	10.7	4.8	8.3	6.6	7.8
Persuasive	21.5	40.1*	28.6	44.2†	27.6	46.1*
Esthetic	3.1	2.9	4.8	0.0	0.0	1.1
Unclassified	9.2	4.5	4.7	7.4	14.4	7.3
Total percentage	99.9	100.0	100.0	100.0	100.0	99.9

* Difference between percentages significant at 0.01 level. † Difference between percentages significant at 0.06 level. ‡ Difference between fathers' occupations for students selecting institutions with "high" and "low" indices of productivity is significant at 0.05 level of significance.

Verbal Explanations of College Choice

For this analysis, the verbal explanations of college choice for all 1956 finalists (group iv) selecting "high" productive colleges were compared with those of an equal random sample of students selecting "low" productive institutions. Male student statements were classified by two graduate student judges having no knowledge of either this report or of similar reports. Female statements were classified by a single judge. The discrepancies in the two judges' coding of verbal reports range from 0.4 to 6.6 percentage points.

For males, the statistically significant differences in Table 3 reveal that a college of "academic standing, small size, research reputation, or liberal arts orientation" is desired more frequently by students selecting institutions with high indices of productivity. Students choosing institutions with low indices are less concerned with these qualities and are more concerned with attending a "good college, one which is close to home, or in a desirable location."

The differences for females form a similar pattern. Women selecting "high" productive colleges prefer a college of "small size" and a "liberal arts orientation." Among women selecting a college with a low index, these qualities are less valued, and attending a "good college, or one of prestige" is held more valuable.

In all, the significant differences in Table 3 appear consistent with the formulation outlined earlier. To interpret, the selection of institutions with high indices appears to be a function of needs for a small social group or organization and a broad, intellectually oriented educational experience. In contrast, the selection of institutions with low indices appears to reflect confidence in living in a large, social group and a more ex-

Table 3. Summary of verbal reports of college choice by high-school seniors selecting "high" and "low" productive institutions.

Reported reasons for choice of institution	Males (No. = 1088)		Significant difference P	Females (No. = 540)		Significant difference P
	H.P.	L.P.		H.P.	L.P.	
Good college	47.9	55.1	< 0.05	35.6	45.6	< 0.05
Close to home	14.3	18.4	< 0.07	12.9	10.0	
Low cost	3.9	5.5		2.9	5.9	
Academic standing	20.6	15.6	< 0.05	33.3	27.4	
Small size	27.9	8.5	< 0.001	38.5	15.2	< 0.001
Recommended by friends and others	15.1	15.8		12.6	11.5	
Good faculty	10.3	8.6		4.1	6.7	
Prestige of college	6.3	5.1		0.0	5.2	< 0.001
Desirable location	9.9	13.6	< 0.06	9.6	10.7	
Religious affiliation	4.2	6.3		8.9	11.1	
Physical facilities	6.8	8.1		0.7	1.9	
Research reputation	2.0	0.2	< 0.01	0.4	0.4	
Liberal arts orientation	17.1	11.2	< 0.01	22.2	10.0	< 0.001
Miscellaneous	25.2	18.6		15.9	29.6	

ternal—perhaps more practical—orientation, including considerations of "prestige" and a "good college."

This evidence also tends to negate the assumed effects of the small, liberal arts college strongly implied by the Knapp studies. The student concentration and motivational hypothesis appears more probable; that is, small, liberal arts colleges may attract a disproportionate number of students who are consciously seeking a small, liberal arts college and are relatively homogeneous and potentially high achievers with respect to scientific and scholarly eminence, And while these criterion colleges may have beneficial and nurturing qualities, the student talent and motivation they receive by virtue of their reputation and orientation may outweigh the college influence itself. In short, differential student populations among colleges appear as a more probable explanation of differences in productivity than the special qualities of individual institutions.

Discussion

The validity of this study rests largely on its sampling of high-school seniors in the United States and on several psychological assumptions concerning the relationship of scientific eminence or scholarship to scholastic aptitude and achievement at the high-school senior level. For 1955, the high-school senior samples appear to be approximately representative of high-aptitude seniors, since an estimated 88 percent of the eligible seniors did participate. Census estimates reveal that the nonparticipating 12 percent is concentrated largely in 13 southern states, a bias which suggests the effect of a more representative sample.

It is likely that the concentration of high-aptitude students in "high" productive colleges revealed by this study would be unaffected by a complete sampling, since these institutions occur very infrequently in the South and with great frequency in the Far West and Middle West. This possibility is reinforced by a previous report which reveals a marked tendency for students to attend colleges close to home or in their own geographic region (*10*).

With respect to psychological assumptions, it is assumed that scientists and scholars are drawn generally from students who are characterized by their high academic achievement in secondary schools and by their high scholastic aptitude and verbal and mathematical aptitudes. This assumption is supported by extensive studies reviewed by Wolfle (*11*).

This study assumes further that early academic achievement is predictive of later scientific eminence (achievement) and scholarship in other areas. For this assumption there is also extensive support. Studies by Cox (*12*), Terman (*13*), and others reveal that later achievement has many forerunners of which academic achievement is only one.

The present study militates strongly against the "institutional hypothesis." In opposition to the latter formulation, the present evidence suggests that differential productivity is probably a function of differential student populations which may be characterized by (i) their divergent proportions of high-aptitude students and (ii) their differences in motivation (scientific and intellectual activities as contrasted with business and oral activities) as well as by a number of implied differences in attitudes and values. The second hypothesis appears to parallel the work of Stern, Stein, and Bloom (*8*), who report marked variability in percentages of personality types or patterns within five divergent institutions. Briefly, high productivity appears to be an expected result of working with an intellectually well endowed student body which tends coincidentally to have a modal orientation toward scientific and scholarly goals. It appears more probable that college productivity indices should be attributed to student characteristics rather than to institutional influences.

This formulation might be modified further by the time dimension. It appears possible that some institutions in their early history may have stimulated in a substantial manner students who later achieved the Ph.D. degree and eminence in science and in other areas and that through such activity these institutions acquired reputations which differentially attracted desired student groups and repelled undesirable ones. As an end-result, investigators are faced with the problem of disentangling the influence of an institution from the quality and character of its student body, both of which are probably changing. In addition, there may be a snowballing effect of college influence, which may be out of proportion to its real effects. This sequence might occur in the following manner. (i) A college influences students to achieve in areas of science and scholarship; (ii) a few talented students respond by attaining fellowships and Ph.D. degrees, and perhaps one becomes a recognized man of science; (iii) prospective students are impressed, possibly by these achievements but more probably by such evaluations as "tough school" and "high standards"; (iv) brighter students with high intellectual goals enroll in great numbers; (v) the odds for the success of college influence are now greater; (vi) there is more achievement; (vii) more bright students enroll, with science or other appropriate scholarship orientation, and students with low academic motivation or motivation for goals which represent the minority of the student body find more suitable institutions; (viii) and so on. This oversimplified analysis suggests that teacher influence may have marked effects on scholar productivity in the early years of the history of a college, but that this influence may decrease to the point where the level and character of the student population become of much greater importance as the institution develops in time.

Summary

An analysis of the college attendance or college choice for four high-aptitude, high-school senior samples suggests that the differential institutional productivity of scientists and scholars is a function of

the differential college attendance, paternal vocational motivations, and their implied correlates among high-aptitude students. This formulation appears to be more probable for males than for females. The institutional productivity hypothesis proposed in previous studies is not supported by the present evidence (*14*).

References and Notes

1. R. H. Knapp and H. B. Goodrich, *Origins of American Scientists* (Univ. of Chicago Press, Chicago, Ill., 1952).
2. R. H. Knapp and J. J. Greenbaum, *The Younger American Scholar: His Collegiate Origins* (Univ. of Chicago Press, Chicago, Ill., 1953).
3. J. L. Holland and R. C. Stalnaker, "A descriptive study of talented high-school seniors: National Merit Scholars," unpublished paper; J. L. Holland and J. M. Stalnaker, "The effects of an honorary scholastic award upon subsequent training, scholarship aid, and personal status," *J. Higher Educ.* in press.
4. Dittoed table from the U.S. Department of Health, Education, and Welfare, Office of Education, Research and Statistical Services Branch, Washington, D.C., 1957.
5. *Opening (Fall) Enrollment in Higher Educational Institutions 1955*, U.S. Dept. Health Educ. and Welfare, Office of Educ., Circ. No. 460 (Washington, D.C., 1955).
6. Specific criteria for classification were based on six keys from the *Holland Vocational Preference Inventory* and an unpublished inventory, which are in general agreement with classification schemes suggested by E. K. Strong, Jr. [*Vocational Interests of Men and Women* (Stanford Univ. Press, Stanford, Calif., 1943)], L. L. Thurstone ["A multiple factor study of vocational interests," *Personnel J.* 10, 198 (1931)], P. E. Vernon ["Classifying high-grade occupational interests," *J. Abnorm. (Soc.) Psychol.* 44, 85 (1949)], and others. This method required some subjective judgment, since the reference lists are not exhaustive. Distributions for a sample of 556 ratings are not significantly different for two raters, and the differences for a single category average 2.6 percent.
7. A. Roe, *The Psychology of Occupations* (Wiley, New York, 1956).
8. G. G. Stern, M. I. Stein, B. S. Bloom, *Methods in Personality Assessment* (Free Press, Glencoe, Ill., 1956).
9. In a personal communication R. H. Knapp reports limited confirmation of this hypothesis. With scholastic ability partialed out, Knapp obtains a correlation of -0.40 between the production of scientists and the production of lawyers among a selected group of institutions by employing the Knapp-Goodrich index for scientists and a similar index developed for determining the production of lawyers.
10. National Merit Scholarship Corporation, *First Annual Report* (Evanston, Ill., 1956).
11. D. Wolfle, *America's Resources of Specialized Talent* (Harper, New York, 1954).
12. M. Cox, *Genetic Studies of Genius, II: the Early Mental Traits of Three Hundred Geniuses* (Stanford Univ. Press, Stanford, Calif., 1926).
13. L. M. Terman and M. H. Oden, *The Gifted Child Grows Up* (Stanford Univ. Press, Stanford, Calif., 1947).

14. I wish to acknowledge the fundamental work of Robert H. Knapp, Hubert B. Goodrich, and Joseph J. Greenbaum, who provided the basic formulation for this problem, in which I merely substituted some new values and samples. I am indebted also to Donald L. Thistlethwaite for a critical review of this paper. This study was partially supported by research grants from the National Science Foundation and the Old Dominion Foundation.

Comparison of Closely Related Faunas

Eugene Munroe

Zoogeography is the science of the distribution of animals as influenced by present and past causes. One of its important tasks is to study differences between faunas that inhabit different geographic areas. Although rough qualitative comparisons can be made fairly easily, their interpretation is beset with pitfalls. When quantitative comparison is attempted, the difficulties are greatly multiplied, and special attention must be given to the methods used. The subject of comparison of faunas is large and complex and cannot be surveyed fully here. This article (*1*) deals primarily with a method useful for comparing closely related faunas, but to place this method in perspective, a short discussion of the general nature of differences between faunas is necessary.

Differences between Faunas

The differences between whole faunas are best thought of as aggregates of differences in the representation of individual taxa (*2*). These differences are of several kinds, with different zoogeographic meanings: (type A) a taxon of one fauna may be unrepresented in another fauna—for example, the pronghorn is present in North America but absent in Eurasia; (type B) a single taxon of one fauna may represent a group of taxa in another fauna—for example, the butterfly genus *Calisto* has one species in Puerto Rico but a considerable number of species in Hispaniola (*3*); (type C) there may be a one-to-one correspondence between groups of taxa, such as the Old-World and New-World monkeys; (type D) there may be a one-to-one correspondence between two individual taxa, such as the European elk and the American moose.

The significance of the simple presence-and-absence differences of type A has been over-emphasized. A taxon may be absent from a locality for any of three reasons: (i) it may never have reached it because of some barrier (most higher mammals are absent from Australia); (ii) having reached a locality, the taxon may have found it unsuitable for colonization (numerous species of insects arrive fairly regularly as strays or migrants in England but fail to become established, *3*); or (iii), having become established, it may subsequently have suffered local extinction (the large copper butterfly has disappeared in England). These causes cannot ordinarily be distinguished on direct evidence, and the absence of taxa, even if established beyond doubt, is an uncertain basis for zoogeographic conclusions—witness, for instance, the controversy over the insular or oceanic nature of the West Indian fauna (*4, 5*), in which arguments based solely on the absence of elements in the present fauna are inconclusive.

Differences of type B, where a single taxon in one place is the counterpart of a group of taxa in another, may also arise in different ways. The isolated taxon may be a colonist from a center of dispersal in which a group of similar taxa survives—the Hawaiian butterfly *Vanessa tameamea* is a segregated species of a genus with several continental representatives. Conversely, the single taxon may be a relict in an otherwise abandoned ancestral habitat—the raccoon is the only surviving procyonid in North America, the original home of the group, but there are a number of species in South America. In such cases the present center of abundance of the group may be a secondary one, quite distinct from the true center of origin or dispersal. Or, finally, the vicarism of single and multiple taxa may be the result of a difference in evolutionary, or, more strictly speaking, of radiative, rates—as already noted, the butterfly genus *Calisto* is represented by

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Table 1. Degree of differentiation within superspecies of Papilionoidea between certain West Indian islands.

Degree of difference within superspecies	Cuba and Cayman Islands	Cuba and Bahamas	Bahamas and Cayman Islands	Cuba and Hispaniola
Specific	0	1	0	9
Subspecific	5	11	10	23
None	23	24	13	35
Not compared	3	5	4	0
Total superspecies in common	31	41	27	67

a single endemic species in Puerto Rico, but by an array of about 20 species in Hispaniola (*3*). Puerto Rico and Hispaniola had a common fauna in the Pliocene (*5*), and at least some of the Hispaniolan species appear to be radiants from a common ancestor shared with the Puerto Rican species, which has not radiated. In this type of vicarism, the group of taxa may have originated either contemporaneously with the vicarious single taxon, as in the example given, or subsequently as a colony from it; the important feature is that radiative differentiation has proceeded more rapidly in one segregate than in the other.

More rapid radiative evolution may sometimes be the result of inherent differences, but it probably is caused most often by characteristics of the environment. Relaxation of biotic competition and geographic compartmentalization are environmental factors favoring radiation. Animals that succeed in colonizing oceanic archipelagoes frequently radiate rapidly to fill empty niches—for example, Hawaiian honey-creepers (*6*) and Galapagos finches (*7*), in contrast to similar animals in continental areas or single islands which do not commonly radiate to the same extent. Indeed, it is a plausible hypothesis that the explosive evolution that characterizes the early history of many successful groups (*8*) follows on the reduction of effective competition by the development of some striking selective advantage. From the foregoing discussion it will be seen that differences of type B, like those of type A, are likely to be of uncertain significance because of the different ways they may have arisen.

Differences of type C, where groups of taxa represent one another without shared elements, almost without exception imply isolation for a time long enough to permit independent radiative evolution of the degree observed. Conceivably, serious reduction of a large homogeneous population could lead to the segregation of wholly different relict arrays of taxa in different refugia. However, such occurrences must be rare, and no convincing example occurs to me. The length and degree of isolation needed for independent radiation vary with groups and circumstances; snails have formed separate endemic faunas on the major islands of the West Indies (*9*), whereas birds (*10*) and most butterflies (*11*) have not; fish perhaps radiate quickly in large tropical lakes (*12*), but evolve slowly in temperate rivers.

By suitable choice of taxa, differences of type C can be reduced to those of type D. I shall therefore restrict type D to instances where the vicarious taxa are of species or lower rank. In closely related faunas, a large proportion of the differences are of this class.

Assessment of Differences between Closely Related Faunas

It is well known that faunas that in reality are closely related may, because of accidental or environmental factors, have very different compositions. Mount Katahdin, Mount Washington, and the different peaks on the Gaspé Peninsula have insect faunas that differ appreciably. These differences almost all result from the accidents of survival, and the arctic and subarctic components of the different faunules all have their close counterparts in the much larger fauna of Labrador. Again, faunas of a sandy and of a forested island might be very different, and yet each be fully matched in a single adjacent mainland fauna. A common method of coping with this problem is always to consider the percentage of taxa in the smaller fauna that also occur in the larger, rather than to analyze the larger fauna in terms of the smaller. This method would work well in comparing the two island faunas with the mainland fauna, but would break down in comparing the fauna of the sandy island with that of the wooded one.

There is a simple way of overcoming the difficulty, although it is not in general use. This is to compare only species that occur or are represented in both faunas—that is, to base the comparison on differences of type D. The average degree of taxonomic difference between vicarious populations is then a measure of the differences between the faunas.

Mayr's concept of the superspecies (*13*) is a useful one in this connection. However, it is necessary to admit the existence of monotypic superspecies—those containing only one species—in addition to the polytypic ones conceived by Mayr. The way this method works can be seen qualitatively by a comparison of the hemispheres. For instance, in Lepidoptera, in the Arctic Zone, practically all superspecies that occur in both hemispheres are represented by the same or closely similar subspecies. In the subarctic there are more distinct subspecies and some distinct species. As we go south in the Temperate Zone, the proportion of distinct species rises, and in the Tropics almost all species except those introduced by man are distinct. Between tropical Africa and tropical Asia, on the other hand, there is much less difference. Although many superspecies are represented by different species in the two continents, many others are represented by the same species, often as indistinguishable populations.

This method of comparison is capable of much more subtle discriminations. Consider the array shown in Table 1 (*14*). The frequency-distribution of the degree of differentiation between Cuba and the Cayman Islands is fairly similar to that between Cuba and the Bahamas, showing that the faunas of the Bahamas and the Caymans have much the same degree of relationship to the fauna of Cuba. The somewhat larger proportion of subspecific differences between the faunas of the Bahamas and Caymans reflects the fact that the faunas have been derived independently from the fauna of Cuba and have had no direct influence on each other. On the other hand, the Cuba-Hispaniola distribution shows a definite shift, with more in the specifically different class and fewer in the identical class, indicating a more distant relationship between these islands, a conclusion with which most zoogeographers would agree. The sensitivity of the method increases with the number of superspecies considered and with the number of grades of difference that can be distinguished.

When applied to such widely different faunas as those of Africa and Asia, the superspecies-comparison method obviously does not tell the whole story. Although a comparison of superspecies may reveal the rank of differences between widely separated faunas, it does not accurately represent their extent. The reason is, of course, that differences of types B and D—that is, differences resulting from radiative evolution—are important in these faunas. This suggests a simple distinction between closely related and distantly related faunas.

Closely related faunas are those whose differences are mainly of the presence-and-absence and simple vicarism types; distantly related faunas are those in which an important part of the differences are the result of independent radiative evolution. As suggested earlier, faunas may on this definition be closely related with respect to one group of organisms but distantly related with respect to another. This presents no logical difficulty; the difference is inherently one of mobility. Cuba is an island for birds but a continent for snails.

For closely related faunas, superspecies comparison is a primary, and, for many purposes, a sufficient, method. However, its limitations must be recognized. It is, for instance, unsuitable for assessing differences caused primarily by differences in environment. Indeed, its very strength is that it tends to minimize or eliminate such differences, revealing the underlying differences of historic origin. Other problems are posed by interpretation. Accurate measurement of differences is one thing; accurate explanation of them is quite another. We tend to think of differentiation within superspecies as being the result of gradual divergence of geographically separated populations. However, with respect to two given localities, this explanation is not necessarily correct.

A superspecies may be represented by different species because they have differentiated *in situ*, implying a long period of isolation. On the other hand, the difference may be one of origin, not of history: the two species may have arrived ready-made from different sources, perhaps contemporaneously and perhaps very recently; or one species may have supplanted the other in one locality but not in the second, again perhaps very recently. Of course, the preservation of distinct populations from different sources may itself be a sign of strong isolation between two localities, but there is considerable evidence that, even in the absence of a serious barrier, immediately related species do not readily coexist in the same restricted area. In the West Indies, for instance, species of northern and southern origin in the Lesser Antilles often meet but seldom overlap—for example, *Pyrgus syrichtus* F. and *Pyrgus orcus* Cr. (*15*). Geologic evidence and the fact that different species pairs meet at different levels in the island chain rule out the possibility that the failure to overlap is caused by an important present or past barrier.

Comparison on a superspecies basis does not in itself distinguish endogenous from exogenous differences. This must be done by studying individual patterns of distribution. The presence of distinct populations in each of a series of well-separated localities is evidence of autochthonous differentiation; certain geographic patterns, and especially similarity to the representative in a suitable source region, suggest immigration of a taxon developed elsewhere. Not all cases are clear-cut, and a considerable proportion of doubtful ones can be expected in the study of an actual fauna.

Even if a series of purely endogenous differences can be isolated, its statistics are not free from bias. What is being measured in such a purified series is the amount of evolutionary differentiation between faunas. Apart from the weakness of purely phenotypic comparison, which can be minimized by the use of sufficiently large series of superspecies, there are certain sources of systematic error. One class of errors arises from differences in evolutionary rate in different populations. It is well known from the work of Wright (*16*) and his followers that different conditions of selection and population size influence rates of evolution. In addition, differential selection in different environments has an effect opposite to that of parallel selection in similar environments. Unfortunately, we usually cannot apply this theoretical knowledge to concrete situations, because we are almost always ignorant of the quantities involved. Another type of systematic error is caused by extinction. Extinction has both a general and a differential effect. On the law of averages, older components of a fauna are more likely to have become extinct than younger ones. Evolutionary differences between isolated habitats therefore tend to be minimized. Extinction is more rapid in small habitats than in large ones (*17*). The fauna of a small habitat is therefore likely to be more youthful and less strongly differentiated than that of a large habitat with a similar history. If colonization from an outside source is possible, these effects may be reinforced, for to the attrition of old superspecies is added the continual arrival of new ones, adding to the undifferentiated element of the fauna.

Conclusion

The comparison of vicarious elements of shared superspecies provides a reasonably accurate and objective measure of the degree of difference between faunas in which autochthonous radiative evolution is not an important factor, but historical interpretation of the differences is beset with errors and bias inherent in the differences themselves rather than in the method of measuring them.

References and Notes

1. This article is contribution No. 3497, Entomology Division, Science Service, Department of Agriculture, Ottawa, Canada.
2. A *taxon*, as defined by the International Commission on Zoological Nomenclature, is a taxonomic unit of any rank.
3. E. Munroe, *J. N.Y. Entomol. Soc.* **58**, 211 (1950).
4. W. D. Matthew *et al.*, *N.Y. Acad. Sci. Spec. Publ.* No. 1 (1939).
5. C. Schuchert, *Historical Geology of the Antillean-Caribbean Region* (Wiley, New York, 1935).
6. D. Amadon, *Bull. Am. Museum Nat. Hist.* **95**, 155 (1950).
7. D. Lack, *Darwin's Finches* (Macmillan, New York and Cambridge, 1947).
8. G. G. Simpson, *Tempo and Mode in Evolution* (Columbia Univ. Press, New York, 1945).
9. A. H. Cooke, *Cambridge Nat. Hist.* **3**, 342 (1895).
10. J. Bond, *Birds of the West Indies* (Academy of Natural Sciences, Philadelphia, Pa., 1936).
11. M. Bates, *Bull. Museum Comp. Zool.* **78**, 71 (1935).
12. E. B. Worthington, in *The New Systematics*, J. Huxley, Ed. (Clarendon Press, Oxford, 1940), pp. 287–302.
13. E. Mayr, *Systematics and the Origin of Species* (Columbia Univ. Press, New York, 1942).
14. E. Munroe, unpublished data.
15. W. P. Comstock, *N.Y. Acad. Sci. Sci. Surv. Porto Rico and Virgin Islands* **12**, 421 (1944).
16. S. Wright, *Proc. 6th Intern. Congr. Genet.* **1**, 356 (1932).
17. E. Munroe, *Proc. 7th Pacific Sci. Congr.* (1953), p. 52.

News of Science

Geothermal Power in New Zealand

Atomic energy for power is being considered by many nations including New Zealand, but its practical application is generally conceded to be many years in the future. Therefore, to fulfill immediate needs, the New Zealand Government has committed itself to an energy source almost as spectacular as atomic power and certainly more unique—subterranean steam.

New Zealand has not suffered from a shortage of power in the modern era, despite a complete lack of significant petroleum deposits and only modest coal reserves, both low in quality and costly to extract. Rather, to compensate for these inadequacies New Zealand has bent her efforts to the development of her considerable hydroelectric potential, and the resulting energy, distributed widely among her 2 million people, has placed the country first (along with Norway in some years) in per capita consumption of electric power.

But a crisis in the offing has been apparent to observers ever since World War II, for, although both of the main islands are mountainous and well watered, most of the practical dam sites in the North Island have been developed in recent years, and the remaining large potential in the snow-fed streams of the central and southern sections of the South Island is not available to the major consuming centers of the north.

And yet the demand for power continues to grow, as does the population, which is increasing at the phenomenal rate of 2 percent per year. Obviously, if New Zealand is to keep her living standard at its present high level and maintain her economic momentum, new sources of energy must be tapped.

In the center of the North Island is one of the world's rare geothermal regions, where ground water comes into extensive contact with hot subterranean rocks and manifests itself at the surface in the form of geyser basins, boiling mud pools, hot springs, and steam jets. Only in Yellowstone National Park and in Iceland are comparable phenomena known, but nowhere is so much activity concentrated in so small an area that is accessible to large population concentrations as in New Zealand. At the northern end of this region is the tourist center of Rotorua, renowned for its geysers and hot springs, its charm enhanced by Maori villagers who act as hosts and guides.

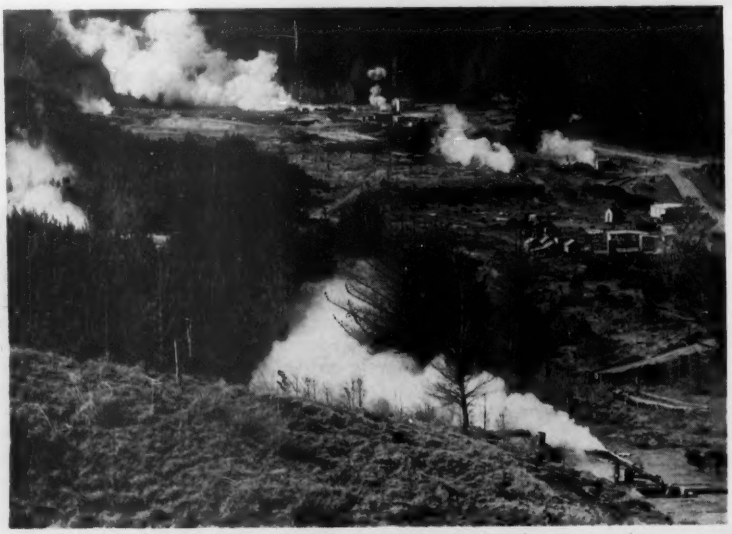
But, farther south in the Wairakei Valley near Lake Taupo, even more violent activity is apparent. Karapiti blowhole, a powerful jet of dry steam, erupts continuously at a pressure of about 180 pounds per square inch and, according to Maori legend, has done so with undiminished force for at least 500 years. Such evidence of subterranean energy has led naturally to speculation on the feasibility of harnessing it for productive purposes.

In 1950 several experimental bores were authorized. This was not entirely a pioneer venture in the utilization of subterranean steam. For years natural steam has been used on a modest scale, both in New Zealand and Iceland, for the heating of homes and domestic water. In Tuscany, Italy, such steam has even been harnessed to generate limited amounts of electricity, and when geothermal power development was first seriously considered in New Zealand, a team of engineers was sent to Italy to study the application of Italian techniques to the local problem. However, the New Zealand project is unique in its scope.

For several years now test bores have been put down over a large area aimed at delimiting the extent of natural steam occurrence, estimated now to be an area of more than 3000 square miles. At present at least 50 bores have been drilled to depths ranging from 500 to 3000 feet, and new equipment has been brought in recently to test even greater depths. There have been no "dry wells." In every case steam has been encountered at head pressures of anywhere from 100 to 430 pounds per square inch. One relatively small and shallow bore, 4 inches in diameter at 575 feet, discharges 130,000 pounds of water and steam every hour, and the roar of the jet can be heard 4 miles away.

The quality of the steam, as well as its quantity, is important. It must be free of impurities which could clog or corrode delicate machinery, and for the best results superheated or dry steam is required, to eliminate as far as possible excessive condensation on turbine blades. Fortunately, New Zealand steam has been shown to contain no harmful chemicals, but some of the early bores at the ground-water level emitted wet steam. However, more recent deeper drilling has tapped large sources of dry steam.

Results of these test bores have been so encouraging that the government has definitely decided to go ahead with a large-scale power development based on geothermal steam. Early in 1957 four construction firms from New Zealand, Scotland, Great Britain, and Switzer-



View of the Wairakei Valley in New Zealand.

land contracted to erect a power station on the banks of the Waikato River near its source at the north end of Lake Taupo, a cooling pump house in the river, and five 20-inch steam pipes to bring the steam from about a mile away.

Originally the £6-million project was to produce not only electricity but also heavy water for the British Atomic Energy Authority, but the authority withdrew from the scheme in 1955 for reasons which have not been made public. Nevertheless, the New Zealand Government has proceeded and expects to feed 69,000 kilowatts of electricity into the North Island power grid by the winter (June, July, and August) of 1958. In the meantime, a firm of London consulting engineers has submitted a report indicating that the plant can be expanded easily to produce 82,000 kilowatts and, if wet steam and hot water converted to steam prove to be practical, can develop a maximum of 250,000 kilowatts. The total cost of this expanded scheme is expected to run to somewhere in the neighborhood of £22 million to £25 million.

It is hardly likely that such a combination of natural and economic circumstances exists anywhere else in the world, and probably the New Zealand experiment cannot be repeated. Nevertheless, it is being watched with interest from many quarters as the first large-scale use of an entirely new source of energy.

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U.S. Mission to the U.S.S.R.

L. L. Newman, assistant chief coal technologist for the U.S. Bureau of Mines, was one of five American specialists in peat who recently visited the U.S.S.R. Five Soviet mining engineers and peat specialists have, in turn, toured Minnesota peat and iron mining sites in an unusual exchange between the state of Minnesota—not the United States Government—and the Soviet Union. Minnesota has an estimated 6 billion tons of peat reserves.

Newman reports as follows: "Impressive machinery of unique and advanced design used in the production of peat in Russia and the warm friendly and cordial reception accorded our mission were beyond all my expectations." The Russians were "not only friendly but eager" to show the American mission their peat production operations around Moscow and Leningrad. The Soviet Union is an acknowledged leader in the chemical aspects of peat use.

There were no restrictions on photographing plant sites or equipment. Newman himself exposed 22 rolls of colored film and four rolls of black and white. In addition, Soviet officials supplied the American mission with four reels of movies about peat operations. Photographs, blueprints, specifications, and brochures were supplied "on any item in which the [group] expressed an interest."

The American visitors were surprised to learn that the chemical aspects of peat use comprise only about 1.5 percent of the Soviet peat program. Eighty percent of the 56 million tons of peat processed each year in the U.S.S.R. goes for power production, and 18 percent is used for fertilizer and soil conditioning.

Newman also reported that in the U.S.S.R. the entire production process is mechanized, with huge, intricate machines preparing the peat bogs and removing the peat. Trees are cut, stumps removed, drainage ditches dug, and the peat itself placed in railroad cars without a human hand touching it.

High-School Teachers Attend M.I.T.

High-school science and mathematics teachers from New England, the Middle Atlantic States, and the South worked for 8 weeks this summer with the research staff at Massachusetts Institute of Technology's School of Science under a $20,000 general assistance program of the Westinghouse Educational Foundation, which is supported by the Westinghouse Electric Corporation. In a new type of program offered for the first time this year, teachers were able to choose research projects in biology, chemistry, food technology, geology and geophysics, mathematics, meteorology, and physics. The program, which has been sponsored by the Westinghouse Educational Foundation for 9 years, provides for grants of $800 for each participating teacher.

In the past, summer activities for science teachers centered around special lectures and laboratory exercises by members of the M.I.T. faculty. These activities were designed to review fundamental science projects and to survey recent developments. However, this year's program allowed teachers to participate directly in the institute's regular research work.

Whitney Opportunity Fellowships

The John Hay Whitney Foundation has announced its Opportunity Fellowships for 1958–59. These awards are open to any citizen of the United States (including residents of territories) who has given evidence of special ability and who has not had full opportunity to develop his talents because of arbitrary barriers, such as racial or cultural background or region of residence. Awards have been made to the following groups: Negroes, Spanish-Americans, Chinese- and Japanese-Americans, American Indians, residents of the Virgin Islands, Puerto Rico, Hawaii, Guam, Alaska, Samoa, and the Appalachian Mountain area.

Candidates are expected to be mature enough to have given positive evidence of superior promise, yet young enough to have their careers before them; in general, they should be between 22 and 35 years old and should have completed their undergraduate college education. Candidates under 35 are given decided preference.

The fellowships are open not only for academic study (graduate) but for any kind of training or experience (journalism, industry, labor, the arts, and so forth) that may be most useful in developing varied talents and varied forms of leadership. Applicants for apprenticeships in such areas as agriculture, industry, and labor will be welcomed. Persons interested in programs of this type should write to the foundation for additional information.

Awards are expected usually to range from $1000 to $3000, depending on the nature of the proposed project and the financial need of the candidate. Applications may be obtained from the John Hay Whitney Foundation, 630 Fifth Ave., New York 20, N.Y. Completed forms must be filed *not later than 30 Nov.*

U.S. Student Enrollment

The U.S. Office of Education reports that for the 13th consecutive year the nation's total school and college enrollment will increase, reaching a new all-time peak of approximately 43,135,000 in 1957–58. Enrollment will be about 1,796,000 higher than the previous record enrollment of 41,366,000 last school year. One of every four persons in the United States will attend school or college.

Public and private school enrollment in kindergarten through grade 8 is expected to total about 30,670,000, nearly 1 million over last year's elementary-school enrollment of 29,711,000. High-school (grades 9 through 12) enrollment for 1957–58 is expected to be 8,424,000, a gain of 604,000 over last year's 7,820,000. For every 100 persons aged 14–17 years, 83 will be enrolled in high school; 10 years ago 74 in 100 were enrolled.

Colleges and universities will enroll about 206,000 more students during the coming academic year than they did in 1956–57—3,450,000 this year compared with 3,244,000 last year. Colleges and

universities, with about 90 percent of the total higher education enrollment, have reported that they expect to spend $3.6 billion on new facilities during the 5-year period 1956–60. This amount would be double the sum spent during the previous 5 years.

Because of increased enrollments in public and nonpublic elementary and secondary schools, about 55,000 more teachers will be needed in 1957–58 than last year. As schools open this fall, there will be a shortage of about 135,000 qualified elementary- and high-school teachers, despite the fact that 81,400 men and women will enter the teaching profession for the first time. The shortage last year was about 120,700.

The continuing teacher shortage will result, as in previous years, in larger classes and the hiring of teachers who do not meet minimum certification standards. About 89,400 such teachers were employed in 1956–57.

The cost of education in public elementary and secondary schools last year, including capital outlay, was $400 per pupil. The total for the country was about $12 billion. A study by the Office of Education shows that 58 percent of the income (excluding receipts from loans and bond issues) for public elementary and secondary education is obtained from local property taxes. State taxes on income, sales, and other business activity provide 38 percent and the Federal Government, 4 percent.

NSTA Aids

Elementary-School Science

The National Science Teachers Association, a department of the National Education Association, is increasing its service to elementary-school teachers in three ways: (i) its present publication, the *Elementary School Science Bulletin,* will be twice as large and be issued eight times a year; (ii) a part-time specialist in elementary science has joined the staff as a consultant and editor; and (iii) NSTA's three conferences for the coming year will emphasize science in the grade schools.

The revised *NSTA Elementary School Science Bulletin* will be off the press in October as a two-color, eight-page publication. It will appear monthly through May, with subscriptions priced at $1 annually per individual and 50 cents each for school groups of five or more persons.

Dorothy Alfke has joined NSTA headquarters staff on a part-time basis and will serve as a field consultant and as coeditor of the new bulletin with Robert H. Carleton, executive secretary. Miss Alfke is a professor at the College of Education at Pennsylvania State University; she received her doctorate from Cornell University in elementary science and nature education.

Science in the elementary grades will come in for major discussion at two NSTA regional meetings, scheduled in Hartford, Conn., 18–19 Oct., and in Indianapolis, Ind., 27–30 Dec., during the AAAS meeting. The national convention in Denver, Colo., 26–29 Mar., will be preceded by a 1-day conference for elementary supervisors.

Italian Nuclear Power Study

The Government of Italy and the World Bank have announced that they have agreed to cooperate in sponsoring a study that will lead to the construction of a large nuclear power station in southern Italy. Previously, Italy had announced that a nuclear power station would be built in the south by the Societa Elettronucleare Nazionale. The Societa is a company whose principal shareholders consist of all the major electric power companies in southern Italy, together with a number of government-controlled metallurgical and engineering corporations.

The study will be known as Project E.N.S.I. (Energia Nucleare Sud Italia), and will include the following steps: (i) the selection of a site for a nuclear power station; (ii) the preparation of invitations to qualified manufacturers, on an international basis, to offer proposals for a nuclear plant of approximately 150,000 kilowatts electric capacity at the proposed site; and (iii) a review of the proposals submitted and the preparation of an evaluation of them, particularly with regard to comparative cost and performance.

The executive responsibility for Italian participation in the project has been given to the Comitato Nazionale per le Ricerche Nucleari, the official institution responsible for nuclear research and development in Italy. The general secretary of the Comitato, Felice Ippolito, and Corbin Allardice, adviser on atomic energy to the World Bank, will together make up the steering committee that will be responsible for over-all direction of the project. The U.K. Atomic Energy Authority and the U.S. Atomic Energy Commission have agreed to provide nuclear engineering consultation.

The World Bank will set up an international panel of specialists to provide general guidance and also to review the proposals and the reports on them provided by the U.K. Authority, the A.E.C., and the project staff. The panel will have a Canadian as chairman and will also include one French representative, one Italian, two U.K. nationals, and two Americans. The panel will transmit its reports to Societa Elettronucleare Nazionale, which will select the most suitable proposal for the construction of the power station.

NSF Survey of Science Faculty

A survey of faculty engaged in scientific research activities in United States academic institutions that was released recently by the National Science Foundation indicates that 70,000 scientists and engineers were employed in 1953–54 by colleges and universities; about half of these people were performing research on a full- or part-time basis. The survey covered 1120 institutions capable of performing research in the natural and social sciences. Other academic institutions in the country are primarily teachers' colleges or are oriented toward education in the liberal arts.

The NSF figures are based on data returned by 987 responding institutions. These institutions reported 62,000 faculty members in the natural and social sciences, and an estimate of 8000 was made for nonrespondents. Of the respondents, 180 were large institutions—that is, primarily those having graduate schools in the scientific professions. These accounted for 46,500 of the total scientific faculty and for 95 percent of the total research time reported.

The reported faculty members included both full- and part-time scientists and engineers engaged in any or all of the usual duties of a faculty member—teaching, research, and community service. Translating part time and full time into full-time equivalents, about 30 percent of the total time was devoted to research activities.

The foundation's report presents the number of faculty in these institutions and the percentage engaged in research in six different types of organizations within the universities: arts and sciences; engineering; public health, medicine, and dentistry; agriculture; research organizations; and other professional schools. About 75 percent of the total faculty employed were in the arts and sciences, engineering, and medical schools.

Scientific fields being investigated by these faculty members are also shown in the report. Approximately one-third of those performing research were in the physical sciences, such as engineering, chemistry, physics, and mathematics; one-third, in the life sciences (biological and clinical); and the other one-third pursue investigations in the agricultural and social sciences.

The supporting research personnel reported by the large (180) institutions

indicate a 1/1 ratio to the faculty. This computation is based on the full-time equivalents for both the faculty and supporting personnel.

The report, *Faculty Scientific Research Activities at Colleges and Universities, 1953–54*, is number 6 in the foundation's series entitled *Reviews of Data on Research and Development*. Copies may be obtained by writing to the National Science Foundation, Washington 25, D.C.

Psychopharmacology Service Center

A clearinghouse of information on psychopharmacology is being established by the Psychopharmacology Service Center of the National Institute of Mental Health. An extensive collection of the literature in this field, including pharmacological, clinical, behavioral, and experimental studies of the ataraxic, psychotomimetic, and other centrally acting drugs, will be classified and coded to enable the staff to answer a wide variety of technical and scientific questions. As soon as enough materials have been assembled, the center plans to offer bibliographic and reference service. It will also prepare critical and analytic reviews of special topics in the field.

In order to accelerate the growth of the literature collection, the center invites people working in this field to provide three copies of any papers that deal with their work—whether reprints, prepublication manuscripts, progress reports, informal mimeographed reports, papers read at meetings, or abstracts. Letters outlining work in progress would also be welcome.

Any restrictions authors may wish to place on the center's use of their papers will be strictly observed. All materials should be addressed to the Technical Information Unit, Psychopharmacology Service Center, National Institute of Mental Health, 8719 Colesville Rd., Silver Spring, Md.

News Briefs

In Africa each year hundreds of rings used to mark migrant birds find their way into native women's jewelry boxes. A Rhodesian ornithologist recently told the Pan-African Ornithological Congress that, although he had broadcast in four dialects asking Africans to return rings found, not one had been handed to the authorities.

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A $1.3-million cyclotron is being planned at Michigan State University. Approval to draw up final plans for the 40-Mev machine, which will not be in operation before late 1960, was granted at a recent meeting of the university's governing board.

* * *

Britain, too, is expecting an Asian influenza epidemic this fall, and has a new vaccine ready. The vaccine will be available to any country that wants it.

* * *

A survey of Canadian university women's careers show that women in science face low salaries, slow promotion, and little or no recognition of their work. These findings were reported in an article on "Wastage of women scientists" in the *Labor Gazette*, monthly publication of the Canadian Labor Department, Ottawa.

* * *

October is National Science Youth Month. For materials available, names and addresses of participating organizations, and so forth, communicate with Science Service, 1719 N St. NW, Washington 6, D.C.

* * *

A new cardiovascular research laboratory at the Albert Einstein College of Medicine has been dedicated to the memory of John C. (Jack) Kriendler, New York restaurateur who died of a heart attack 10 years ago. A grant of $60,000 for the laboratory was made by the Jack Kriendler Memorial Foundation.

* * *

General Motors has started the first company school to train workers in handling radioactive material. The first six-man class has graduated from the 10-week course at General Motors Technical Center, Warren, Mich. Until now, industry has trained men in handling radioactive equipment by sending them to study briefly under Atomic Energy Commission auspices or at nearby colleges and universities.

* * *

Radical changes in the amount or type of fats consumed by the general public cannot be justified as a means of reducing the incidence of heart attacks or strokes, according to a report of the Nutrition Committee of the American Heart Association. The report, which was prepared in conjunction with the American Society for the Study of Arteriosclerosis, appears in the August issue of the AHA's journal *Circulation*.

Proposed Legislation

Of the many bills introduced in Congress, some have a special relevance to science and education. A list of such bills recently introduced follows:

S 2737. Provide scientific scholarships and fellowships for children of veterans and other individuals from interest resulting from investment of certain funds obtained under provisions of the Trading with the Enemy Act, and provide for repayment from such funds of certain American war claims against Germany and Japan. Smathers (D Fla.) Senate Judiciary.

HR 9170. Promote welfare of people by authorizing appropriation of funds to assist states and territories in further development of their programs of general university extension education. Elliott (D Ala.) House Educational and Labor.

S 2746. Authorize establishment of three positions for specially qualified scientific and professional personnel in Department of Health, Education, and Welfare. Carlson (R Kan.) Senate Post Office and Civil Service.

HR 9216. Provide for research and technical assistance re control of salt-marsh and other pest mosquitoes of public health importance and mosquito vectors of human disease, protect wetland resources. Moulder (D Mo.) House Interstate and Foreign Commerce.

HR 9121. Provide for construction of a geophysical institute in the Territory of Hawaii. Burns (D Hawaii). House Interior and Insular Affairs.

Scientists in the News

PAUL D. FOOTE, physicist of Washington, D.C., has been nominated by President Eisenhower to be Assistant Secretary of Defense for research and engineering. Foote's post will combine jobs for which there formerly were two assistant secretaries. CLIFFORD C. FURNAS was the former assistant secretary for research and development and FRANK NEWBERRY was assistant secretary for engineering.

Foote is a retired vice president of Gulf Oil Corporation, where he headed the research and development programs. Before that, he was senior physicist for the U.S. Bureau of Standards in Washington for 16 years.

WILLIAM R. BASCOM, professor of anthropology at Northwestern University, has been appointed professor of anthropology and director of the Museum of Anthropology on the Berkeley campus of the University of California. Bascom is a specialist on Africa and spent 4 years in that country as a special representative of the U.S. Foreign Economic Administration during World War II.

SHERWOOD K. HAYNES, professor of physics at Vanderbilt University, became head of the department of physics

and astronomy at Michigan State University on 1 Sept. Active in nuclear research since 1939, Haynes has been a member of the Vanderbilt faculty since 1945. His major areas of research have included cosmic rays, radar, beta-ray spectroscopy, and medical physics.

STANLEY L. WHITCHER, for the past 2½ years head of the chemistry branch at the Naval Ammunition Depot, Quality Evaluation Laboratory, Oahu, T.H., has accepted an appointment as a supervisory chemist (radiological) at the U.S. Radiological Defense Laboratory in San Francisco.

MARTIN H. MOYNIHAN of Cambridge, Mass., has been appointed resident naturalist of the Smithsonian Institution's Canal Zone Biological Area, a tropical forest and wildlife preserve on Barro Colorado Island in Gatum Lake, Canal Zone. Moynihan attended Oxford University, England, from 1950 to 1955 for graduate study of the behavior of the European black-headed gull and some related species as well as of other birds. Since then he has been a visiting fellow at Cornell University and a research fellow at Harvard University, although most of his actual work has been outside of the United States.

REGINALD R. HAWKINS, chief of the New York Public Library's science and technology division has retired after 31 years of service. He joined the library after his graduation from Miami University in 1926. In 1942 he became acting chief of the science and technology division and later that year was promoted to chief. Besides being a science bibliographer, Hawkins is the author of several books for household hobbyists. His latest book is *Easy to Make Outdoor Play Equipment.*

HAROLD W. KUHN of Secane, Pa., has been named executive secretary of the Division of Mathematics at the National Academy of Sciences–National Research Council. He will continue to serve as associate professor of mathematics at Bryn Mawr College, and as consultant to the Logistics Project of the Office of Naval Research at Princeton University. In his new post, Kuhn will have senior staff responsibility for the work of the Division of Mathematics—including its undertakings in the furtherance of mathematics and mathematical training, its advisory services to governmental agencies, and its organization of U.S. delegations to international scientific unions.

The following staff changes have taken place in the biology department at the University of Oregon. RALPH R. HUESTIS is retiring this year to become professor emeritus of biology after 33 years of service. He was head of the department from 1953 to 1956. B. T. SCHEER, acting head during 1956–57, will be on sabbatical leave working in France on a Guggenheim fellowship; C. W. CLANCY will be acting head for 1957–58. PETER W. FRANK of the University of Missouri has joined the staff as associate professor.

BERNARD B. BRODIE, chief of the Laboratory of Chemical Pharmacology at the National Heart Institute, is spending 6 weeks in Europe, where he will lecture on drug action and on the biochemical aspects of brain function. He will visit Zurich, Basel and Berne, Helsinki, Stockholm, Lund, Oslo, Amsterdam, London, and Dundee before he returns in October.

At the second International Symposium on Mammary Gland Tumors that was held at the University of Perugia, Perugia, Italy, in July, a special convocation of the faculty was held at which three honorary M.D. degrees in medicine and surgery were presented to three candidates *honoris causa.* The recipients were JOHN J. BITTNER, director of cancer research at the University of Minnesota; ALEXANDER HADDOW, director of the Chester Beatty Institute, London; and LEONELL C. STRONG, director of the Biological Station of the Roswell Park Memorial Institute, Springville, N.Y.

S. D. SHIRLEY SPRAGG, professor of psychology at the University of Rochester, has been appointed acting dean of the university's new Council of Graduate Studies. The council, created under the reorganized plan for administration of graduate study, is concerned with overall supervision and policies on work for the Ph.D. degree. Offices of associate dean for graduate study have been established in each division of the university. WALLACE O. FENN, chairman of the department of physiology, is the associate dean for the Medical School.

Recent Deaths

GEORGE BURRELL, New York, N.Y.; 75; chemical engineer and founder and chairman of the board of the Burrell Corporation; in World War I helped to organize the Army's chemical warfare service and aided the establishment of this country's helium program; 16 Aug.

JOEL E. CROUCH, Hoboken, N.J.; 57; associate professor of industrial engineering at Stevens Institute of Technology for 10 years; 15 Aug.

FLORENCE R. DAY, Northampton, Mass.; 59; retired director of the Smith College School for Social Work; former professor of social casework at Western Reserve University; organized the Graduate School of Social Science at the University of Denver; 15 Aug.

WILLIAM J. DIECKMANN, Chicago, Ill.; 59; professor of obstetrics and gynecology at Lying-in-Hospital of the University of Chicago; former chairman of the university's department of obstetrics and gynecology; specialist in eclampsia and the toxemias of pregnancy; 15 Aug.

IRVING LANGMUIR, Schenectady, N.Y.; 76; chemist and physicist at General Electric Company for 41 years; received the 1932 Nobel prize for research in chemistry; specialist in electron emission and gaseous discharges; pioneer in surface chemistry; 16 Aug.

EDGAR LOVETT, Houston, Tex.; 86; first president of the Rice Institute; former professor and head of the department of astronomy at Princeton University; 13 Aug.

LAWSON G. LOWREY, New York, N.Y.; 66; psychiatrist and specialist in the field of child guidance; taught at the College of Physicians and Surgeons of Columbia University; 16 Aug.

WILLIAM MOSS, Athens, Ga.; 86; specialist in blood grouping, blood diseases, and the development of immunity to infectious diseases; formerly at the University of Georgia School of Medicine; 12 Aug.

JOHN REICHEL, SR., Philadelphia, Pa.; 71; bacteriologist and pioneer in research on penicillin and blood plasma; former president of the Reichel Laboratory at Kimberton; consultant for commercial laboratories who headed Sharp and Dohme Laboratories, Glen Olden, and was for 30 years at the H. K. Mulford Laboratories; 16 Aug.

RICHARD B. RHODY, Menominee, Mich.; 35; professor in the radiation and research laboratory at the University of Iowa; 14 Aug.

CARL-GUSTAV ROSSBY, Stockholm, Sweden; 59; professor at Stockholm University and chief of the Stockholm Meteorological Institute; former assistant chief for research and education of the U.S. Weather Bureau; taught meteorology at Massachusetts Institute of Technology and the University of Chicago and started the first U.S. meteorological school at M.I.T.; president of the American Meteorological Society in 1944–45; invented the Rossby Parameter for forecasting weather by using upper-air soundings; 19 Aug.

C. F. STOERMER, Oslo, Norway; 84; mathematician, geophysicist, and specialist in cosmic rays; 13 Aug.

RUDOLF WEIGL, London, England; 74; Polish scientist who developed a vaccine against typhus; 11 Aug.

Reports

Phenylalanine and Tyrosine Metabolism in E. coli Strain K-12

A previous report (*1*) from this laboratory described the inhibition by β-hydroxyphenyl-DL-alanine (phenylserine) of the growth of *Escherichia coli* strain K-12 and two of its mutants, a phenylalanine auxotroph and a tyrosine auxotroph. Although, under certain conditions, L-tyrosine and L-phenylalanine each acted as a competitive antagonist of phenylserine for strain K-12, the experimental data were in accord with the view that phenylserine specifically inhibits the utilization of phenylalanine but not of tyrosine, and that, in the presence of the antimetabolite, exogenous tyrosine may serve as a precursor of the phenylalanine required to overcome the inhibition. The latter hypothesis has now been tested directly by growing strain K-12 in the presence of both phenylserine and L-tyrosine-C^{14}, and by isolating phenylalanine and tyrosine from the bacterial protein (*2*).

Strain K-12 was grown in 6 lit of a synthetic basal medium (*1*, *3*) containing, per liter, 3.75 g of glucose, 5.5 mmole of phenylserine, and 0.14 mmole of L-tyrosine, plus sufficient uniformly labeled L-tyrosine-C^{14} (*4*) to provide 2054 count/min μmole of L-tyrosine in the medium. The culture was incubated under forced aeration for 25 hours at 35°C. Preliminary experiments had shown that, under such highly aerobic conditions, 5.5 m*M* phenylserine completely inhibited bacterial growth in the basal medium for 25 hours or longer and that the addition of at least 0.14 m*M* L-tyrosine was required to overcome the inhibition.

The cells were harvested by centrifugation and were washed first with 200 ml of cold 0.9 percent saline containing 0.5 mmole of unlabeled L-tyrosine and then once with 0.9 percent saline, twice with water, and three times each with absolute ethanol and with ether. The resultant bacterial powder (in the amount of 1.6 g) was hydrolyzed in 25 ml of 6*N* hydrochloric acid in a stream of N_2 for 25 hours, and the hydrolyzate was concentrated in a vacuum to remove excess acid. The residue was suspended in 120 ml of water and filtered, and the filtrate was shaken with about 3 g of acetic acid-washed Darco-G 60 to adsorb the aromatic amino acids (*5*). After the Darco had been washed well with water, it was shaken with two 50-ml portions of 95 percent ethanol to elute the adsorbed amino acids (phenylalanine, tyrosine, and some arginine).

The ethanol solution was concentrated to dryness, the residue was taken up in 1 ml of 4*N* hydrochloric acid, and the amino acid mixture was subjected to column chromatography on Dowex 50 resin (*6*). The column was eluted with 4*N* hydrochloric acid, and tyrosine and phenylalanine were isolated from the appropriate fractions.

The tyrosine was recrystallized three times from water to constant radioactivity; the yield was 10.3 mg. The phenylalanine was freed of impurities derived from the resin by paper chromatography on washed Whatman No. 54 paper, first with butanol-pyridine-water (2/1/1) as the solvent and then with butanol-acetic acid-water (4/1/1) as the solvent. Finally, the material was dissolved in hot 95 percent ethanol, the solution was filtered, and after removal of most of the solvent, and chilling, 9.3 mg of phenylalanine was obtained. The purity of the isolated compounds was checked by paper chromatography prior to C^{14} analysis in a gas-flow counter in the Geiger region.

Several samples of bacterial tyrosine were counted (sample weights 0.071 to 0.289 mg) and had a specific radioactivity equivalent to 2334 count/min μmole of amino acid. The bacterial phenylalanine contained a barely detectable amount of C^{14}; the specific radioactivity of the sample counted (1.113 mg) corresponded to about 0.19 count/min μmole of phenylalanine.

The work of Davis (*7*) and his associates has established that, in *E. coli*, phenylalanine and tyrosine are formed by independent pathways from a common precursor, prephenic acid. In the experiment described in preceding paragraphs, none of the prephenic acid formed by bacteria grown in the presence of phenylserine and L-tyrosine-C^{14} was used for the synthesis of bacterial tyrosine, since the specific radioactivity of the isolated amino acid (2334 count/min) was equivalent to that of the tyrosine supplied in the medium (2054 count/min). The absence of significant C^{14} from the bacterial phenylalanine indicates that all the bacterial phenylalanine must have been synthesized from prephenic acid derived from glucose and shows clearly that no phenylalanine was formed from exogenous tyrosine. It may be concluded, therefore, that the conversion of prephenic acid to tyrosine is essentially irreversible, even under conditions where the bacteria require large amounts of phenylalanine. In this connection, it is of interest that the conversion of prephenic acid to phenylalanine also is irreversible, since studies with auxotrophic mutants of strain K-12 indicate that these bacteria do not make tyrosine from phenylalanine (*8*).

The ability of exogenous tyrosine to overcome the inhibitory action of relatively low concentrations of phenylserine, therefore, may be ascribed to the "sparing" action of exogenous tyrosine on bacterial prephenic acid. This sparing action would permit the biosynthesis of the extra phenylalanine required by the bacteria for growth in the presence of phenylserine. The amount of extra phenylalanine formed should be proportional to the amount of prephenic acid spared, and this, in turn, should depend on the concentration of exogenous tyrosine. The observed effect, therefore, will be a competitive antagonism between tyrosine and phenylserine.

The foregoing data may also be explained by an alternative hypothesis, analogous to that of Cohen and Rickenberg (*9*) for the competitive antagonism between other bacterial amino acids and their antimetabolites. According to this view, exogenous tyrosine would exert its antagonism to phenylserine by preventing the uptake of the latter from the medium by the bacterial cells. However, phenylserine does not compete with phenylalanine for entrance into *E. coli* cells (*9*), and it is unlikely that it competes with tyrosine. Furthermore, the inhibition of the growth of strain K-12 and, especially, of its phenylalanine auxotroph by phenylserine can be enhanced by the addition of tyrosine to the medium (*1*). Since, in the absence of phenylserine, tyrosine is not inhibitory, the synergistic effect of the tyrosine-

All technical papers and comments on them are published in this section. Manuscripts should be typed double-spaced and be submitted in duplicate. In length, they should be limited to the equivalent of 1200 words; this includes the space occupied by illustrative or tabular material, references and notes, and the author(s)' name(s) and affiliation(s). Illustrative material should be limited to one table *or* one figure. All explanatory notes, including acknowledgments and authorization for publication, and literature references are to be numbered consecutively, keyed into the text proper, and placed at the end of the article under the heading "References and Notes." For fuller details see "Suggestions to Contributors" in Science 125, 16 (4 Jan. 1957).

phenylserine mixtures implies the entrance of both of the amino acids into the bacterial cells rather than the selective exclusion of phenylserine by tyrosine.

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References and Notes

1. S. Simmonds, M. T. Dowling, D. Stone, *J. Biol. Chem.* 208, 701 (1954).
2. This study was aided by grants from the Nutrition Foundation and the Rockefeller Foundation.
3. C. H. Gray and E. L. Tatum, *Proc. Natl. Acad. Sci. U.S.* 30, 404 (1944).
4. From the Nuclear Instrument and Chemical Corp., Chicago, Ill.
5. S. M. Partridge, *Biochem. J.* (*London*) 44, 521 (1949).
6. W. H. Stein and S. Moore, *Cold Spring Harbor Symposia Quant. Biol.* 14, 179 (1949).
7. B. D. Davis, *Harvey Lectures* 50, 530 (1956).
8. S. Simmonds, E. L. Tatum, J. S. Fruton, *J. Biol. Chem.* 169, 91 (1947); S. Simmonds, *ibid.* 185, 755 (1950).
9. G. N. Cohen and H. V. Rickenberg, *Ann. inst. Pasteur* 91, 693 (1956).

12 June 1957

Bony Mechanism of Automatic Flexion and Extension in the Pigeon's Wing

In 1875 Garrod (*1*) noted that Bergmann, and later Strauss-Durckheim, had earlier described a mechanism for automatic flexion and extension in birds' wings. Garrod also credited Alix for an observation of the same thing, reported in 1874 in Paris. Coues (*2*) further described the device. The function was suggested from gross examination of dissections, and no experimental evidence was offered. Since the date of these papers, no further research on this apparatus has been published.

Briefly, the theory of operation was that the radius and ulna move in a fashion similar to a pair of "drawing parallels." The proximal end of the radius butts against the humerus, while the distal end is in contact with the fused carpals (scapholunar), which in turn are in contact with the anterior (digit II side) surface of the carpometacarpal articulation (Fig. 1). Humeroulnar flexion forces the radius distally, and the radius forces the manus into a flexed position, using the distal end of the ulna and the fused posterior carpal bones (cuneiform) as the fulcrum. Extension at the humeroulnar joint, through ligamentous attachments between the various bones, pulls the radius proximally and drags the manus into an extended position (with the same distal fulcrum as in flexion).

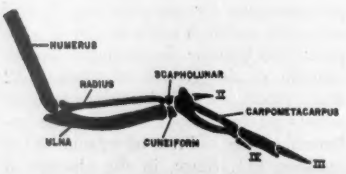

Fig. 1. Diagram of bones in pigeon's wing.

Experiments were devised to test these views of bone movement in the bird's wing. In two domestic pigeons, *Columba livia*, all flexors of the manus were cut; the birds were under general anesthesia, and it was a simple matter to cut all flexor tendons at the "wrist." After recovery from the operation, these birds flew in near-normal manner, but when they were perched the manus seemed to droop (extend) slightly. After 1 month, flight was so nearly normal that it was difficult to distinguish experimental birds from others in the room.

Cutting of the extensor tendons to the manus caused some further loss of delicate control, but the birds soon were able to fly. Eventually, these birds that had no muscular control of the hand flew easily, but they were always distinguishable in their awkwardness.

In two other pigeons, surgery was used to shorten the radius and prevent its simultaneous contact with the humerus and scapholunar. The left and right forewings were entered dorsally and a 5-millimeter section of the radius was sawed from the middle of the length of this bone. After insertion of a bone pin in the marrow cavity, the cut ends of the radius were pulled together with metal sutures. After recovery, the birds could fly, and wing-action was nearly the same as before the operation.

The flexor tendons for the hand were then cut. The birds could not fly, and the manus remained in an extended position at all times. Further surgery, to cut the extensor tendons, caused the hand to dangle, without visible control.

An attempt was subsequently made in each wing to remove the bone pin and insert a longer one to bring the radius back to its normal length. This was successful only on one side of one of the two birds; in the three other sites of bone shortening there had been too great a deposit of calcium on the outside of the bone to permit further surgery. The manus of the one wing in which the length of the radius had been restored was flexed and extended as the bird jumped from perch to perch.

At autopsy it was found that the radius had been shortened only 3 millimeters in one instance and 4 millimeters in the other two; normal length in the radii, as measured from x-ray photographs, was 48 millimeters.

It thus seems evident that flexion and extension of the manus can be accomplished without contraction of muscles extending to the manus. Flexion and extension at the humeroulnar joint, through action of the muscles of the upper arm, causes the same actions at the wrist.

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References

1. A. H. Garrod, *Proc. Zool. Soc. London* (1875), p. 82.
2. E. Coues, *Publ. Am. Assoc. Advance. Sci.* 20, 278 (1871).

14 June 1957

Liquid Scintillation Counting of C^{14}- and H^3-Labeled Amino Acids and Proteins

The method for tritiation of organic compounds described by Wilzbach (*1*) makes it possible to prepare with relative ease a wide variety of labeled compounds of high specific radioactivity. The applicability of the method in the labeling of intact protein molecules has now been demonstrated (*2*). Although the labeling procedure leads to degradation of a portion of each sample, a good yield of native protein of high specific radioactivity is obtained, as is evidenced by chromatographic homogeneity and retention of full enzymatic activity.

Effective use of these compounds in biological studies depends on the availability of a simple and sensitive system for radioassay. This is provided by the liquid scintillation counting technique. But, because the phosphors used in this system are nonpolar and are generally incorporated into an organic solvent (*3*), significant quantities of highly polar substances such as amino acids and proteins cannot be dissolved in the phosphor solution in unmodified form. A method for suspending such material in scintillating gels has been described for use in counting C^{14}-labeled compounds (*4*), but this is not applicable to the assay of tritium.

Passman *et al.* (*5*) have reported the use of a methanolic solution of the hydroxide form of a quaternary amine, Hyamine (*6*), to form a complex with $C^{14}O_2$ which is soluble in organic solvents, thus making it possible to dissolve up to 5 mmole of $C^{14}O_2$ in 35 ml of phosphor-containing toluene. As is described in the next paragraph, this same quaternary amine hydroxide (and several other quaternary amine hydroxides —for example, choline and tetraethyl ammonium hydroxide) can also complex amino acids and intact proteins. The phosphor dissolved in toluene can then be added to the methanolic solution of protein-amine complex, providing a clear

homogenous solution for assay in the scintillation counter.

The sample of protein or amino acid to be dissolved is weighed directly into the glass vial to be used for counting (7), and to it is added 1 ml of 1*M* Hyamine in the hydroxide form in methanol prepared according to Passman *et al.* (4). After the sample is completely dissolved, 10 ml of 600 mg percent diphenyloxazole (DPO) in toluene is added, and the contents of the vial are mixed.

Alanine, leucine, phenylalanine, tyrosine, and tryptophan are each soluble to a concentration of at least 20 mg/ml of Hyamine solution. Aspartic acid is somewhat less soluble than the afore-mentioned amino acids, and as little as 5 mg of arginine cannot be completely dissolved in 1 ml. It has been found that up to 10 mg of the following crystalline proteins dissolve readily at 37°C: insulin, ribonuclease, lysozyme, ovalbumin, and bovine serum albumin. Mixed tissue proteins [precipitated and washed with trichloroacetic acid (TCA), followed by ethanol-ether (1/1) and ether] dissolve with more difficulty, but 10 mg can be taken up in 1 ml of the amine solution by capping the vials and heating to 55° to 60°C for 1 to 2 hours.

After solution is complete and the vials have cooled to room temperature, 10 ml of DPO in toluene is added, as with the other samples. The vials are then cooled to the temperature of the counting chamber (−10°C). Samples of protein or amino acid containing salt (such as are obtained from column chromatography) can be taken up in the Hyamine solution satisfactorily, even though the salt does not dissolve.

With the exception of insulin, the afore-mentioned crystalline proteins do not cause quenching in amounts up to 10 mg per sample, and the counting efficiency with this method is approximately 5 percent. Insulin causes a decrease in the observed counting rate for tritium of from 14 to 57 percent as the amount of insulin is increased from 5 to 20 mg. Quenching is marked with the TCA-precipitated tissue proteins. Solutions of these denatured proteins frequently have a yellow-brown color. The intensity of the color varies with protein preparation, concentration of protein, and time of heating. The relationship between amount of protein and observed counts per minute is not linear for these preparations. As is shown in Table 1, the magnitude of this quenching effect can be determined by adding a standard amount of tritium-containing compound to all of the sample vials and recounting them. By means of the ratio of the increment in counting rate owing to the addition of standard for each vial to the counting rate for the standard alone, the counting rates of the unknown samples can be corrected for quenching. The corrected counting rates are linearly related to the amount of tritiated protein in the range from 2 to 10 mg. This method also corrects for differences in quenching that result from variable losses of methanol during heating and for variation in the counting vials. Because the intensity of color of the solution in the vials tends to increase on standing, it is important to make the quenching correction shortly after the sample is counted.

Table 1. Correction for quenching effect of trichloroacetic acid-precipitated protein.

Protein weight (mg)	Observed count/min minus background	Specific activity observed (count/min mg)	Increment in count/min owing to addition of standard*	Specific activity corrected for quenching (count/min mg)†
2	3933	1966	12081	2685
4	6658	1664	11260	2440
6	8295	1382	9578	2383
8	9523	1190	7613	2581
10	10685	1068	6722	2620

* Standard = 16,500 count/min of tritium-labeled Δ4-cholestenone.

† Observed count/min − background $\times \frac{16{,}500}{\text{increment in count/min owing to addition of standard}} \div$ sample weight

In the course of these studies, it has been noted that vials containing only methanol, Hyamine, toluene, and DPO give spuriously high counting rates (up to 500 count/min) when warm. As the temperature of the vial falls to that of the counting chamber, the counting rate returns to the normal background level (about 35 count/min). This phenomenon is observed only at the high voltages used for counting tritium. It does not occur when Hyamine is omitted from the solution—that is, with toluene and DPO alone—although it is evident when other quaternary amines are substituted for Hyamine. This effect of temperature is also observed when Hyamine is used with DPO in dioxane rather than in toluene solution.

A simple method for preparing samples of tritium or C^{14}-labeled amino acids and proteins for radioassay in the liquid scintillation counter has been described here. It will be evident that there are many possibilities for modifying the composition of the counting solution. For example, microgram quantities of ribonuclease dissolved in 0.5 ml of formamide can be counted satisfactorily after the addition of a solution of DPO in dioxane. However, the method that has been outlined would appear to be satisfactory for many purposes, and thus far none of the variations explored have been found to be of particular advantage. The ability to assay tritium directly in amino acids and proteins, coupled with the ease of labeling these compounds or their precursors with tritium by the Wilzbach technique (2) should provide a new tool for application to studies of protein synthesis and metabolism.

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References and Notes

1. K. E. Wilzbach, *J. Am. Chem. Soc.* 79, 1013 (1957).
2. D. Steinberg *et al.*, *Science*, this issue.
3. M. Furst, H. Kallman, F. H. Brown, *Nucleonics* 13, No. 4, 58 (1955).
4. F. N. Hayes, B. S. Rogers, W. H. Langham, *Nucleonics* 14, No. 3, 48 (1956).
5. J. M. Passman, N. S. Radin, J. A. D. Cooper, *Anal. Chem.* 28, 484 (1956).
6. Para-diisobutyl cresoxy methoxy ethyl dimethyl benzyl ammonium chloride monohydrate = Hyamine-10x, Rohm and Haas Co., Philadelphia, Pa.
7. Five-dram vials, obtained from the Wheaton Glass Co., Millville, N.J.

12 June 1957

Preparation of Tritiated Proteins by the Wilzbach Method

Wilzbach has recently described a simple procedure for introducing tritium into organic compounds (1). The compound to be labeled is exposed to 5 to 10 c of carrier-free tritium gas for several days at room temperature. Toluene, cholesterol, and digitoxin were labeled and found, on purification, to have specific radioactivities of 22.2, 64.3, and 90 mc/g, respectively. The labeling procedure caused some degradation, but this was considerably less extensive than that observed with the triton-recoil method (2). In view of the mild conditions used, it appeared possible that the method could be applied to the labeling of proteins. Preliminary results on the tritiation of lysozyme and ribonuclease by the Wilzbach method are described here.

Crystalline lysozyme (*3*) in the amount of 237 mg was exposed at room temperature to 1.8 c of tritium gas at a pressure of 0.39 atm for 72 hours (*4*). The specific enzymatic activity of the tritium-labeled protein was 90 percent of that of the nonlabeled material. Labile tritium was removed by dissolving the protein in water (5 mg/ml), then lyophilizing. This was repeated twice. A sample of the protein (22.5 mg) was then taken up in 5 ml of *p*H 6.5, 0.2*M* phosphate buffer and chromatographed on a 0.9 by 20-cm column of IRC-50, according to the method of Goncalves *et al.* (*5*).

The effluent fractions were examined for (i) optical density at 280 mμ; (ii) total protein, by the method of Lowry (*6*), with a reference curve prepared with nonlabeled lysozyme; (iii) enzymatic activity, by the method of Tallan and Stein (*7*); (iv) tritium radioactivity, by the method described in the accompanying report by Vaughan, Steinberg, and Logan (*8*) to permit direct assay in a liquid scintillation counter (*9*).

As is shown in Fig. 1, a single major protein peak was eluted, which emerged at the point where untreated lysozyme usually appears. The curves for enzymatic activity and radioactivity coincided exactly with the curve for total protein, as is indicated by the relatively uniform values for specific enzymatic activity and specific radioactivity in successive tubes.

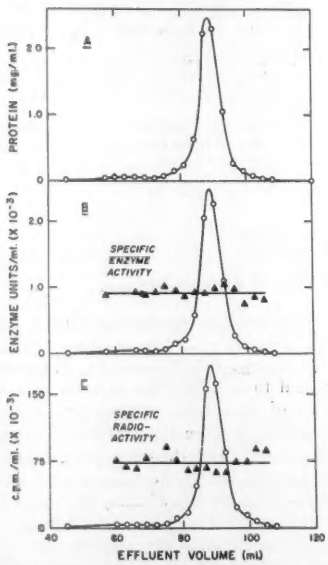

Fig. 1. Chromatography of tritiated lysozyme on IRC-50. (*A*) Total protein by method of Lowry (*6*). (*B*) Enzyme activity by method of Tallan and Stein (*7*). Solid triangles indicate specific enzyme activity in arbitrary units. (*C*) Tritium radioactivity by method of Vaughan *et al.* (*8*). Solid triangles indicate specific radioactivity in arbitrary units.

The specific enzymatic activity in the peak was 23 percent higher than that for the unfractionated labeled material. The specific radioactivity, on the other hand, was distinctly lower—only 1.87×10^5 count/min mg compared with 3.63×10^5 count/min mg before chromatography—and none of the other effluent fractions collected contained significant amounts of tritium. Only about one-half of the total nonlabile tritium was recovered in the peak, whereas the recoveries for total protein and enzymatic activity were 93 percent and 90 percent, respectively. This suggests the presence in the starting material of an enzymatically inactive component of high specific radioactivity, presumably formed by degradation during exposure to tritium, which remained tightly bound to the resin. A direct count on an aliquot of the resin confirmed the presence of tritium-containing material not eluted under the conditions used for chromatography.

In addition to the major peak, there was a very small but definite minor peak eluted just before it. The protein of this minor component was found to have the same specific enzymatic activity and specific radioactivity as that in the major peak.

Crystalline ribonuclease (*10*) in the amount of 570 mg was exposed at 25°C to 6.73 c of tritium gas for 48 hours (*11*). The specific enzymatic activity of the tritium-labeled protein, determined by the method of Anfinsen *et al.*, was 82 percent of that for the unlabeled material (*12*). Labile tritium was removed by dissolving the protein in 0.1*N* NH_4OH and then lyophilizing. The protein was taken up in 0.2*M* *p*H 6.17 phosphate buffer and chromatographed on IRC-50, according to the method of Hirs, Moore, and Stein (*13*). A degraded fraction of very high specific radioactivity but without enzyme activity emerged with the front. This was incompletely resolved from the enzymatically active peak which followed. Because of the incomplete resolution, the degree of homogeneity of the enzymatically active peak could not be evaluated. However, the peaks of radioactivity, enzyme activity, and total protein (optical density at 280 mμ) coincided, and, in the descending limb at least, the enzyme specific activity and the specific radioactivity were reasonably constant in successive tubes.

These studies demonstrate the applicability of the Wilzbach method to the preparation of tritiated proteins. Although there is some degradation during the labeling procedure, good yields of chromatographically pure, enzymatically active protein are obtained, at least in case of lysozyme and ribonuclease. Since only a very small fraction of the enzyme molecules is actually labeled, it is impossible to be certain that the tritium-containing protein molecules are themselves enzymatically active, nor can subtle changes in structure be completely ruled out. Studies to characterize these labeled proteins further are in progress.

Many applications of this method suggest themselves. The fate of intact, internally labeled proteins in biological systems can be studied without the complications introduced when iodination or other "external" labels are used. The method should be particularly valuable for the preparation, in labeled form, of proteins present in the organism in very small quantity, such as the protein hormones, and for the preparation of labeled human proteins, since in these cases it is difficult or impossible to obtain satisfactory labeling by biosynthetic methods. Complex peptides of known structure can be prepared in labeled form by specific proteolytic degradation of tritium-labeled pure proteins or by tritiation of specific fragments derived from breakdown of unlabeled proteins. These labeled peptides, difficult to prepare by synthetic methods, should be valuable in studies of protein biosynthesis.

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References and Notes

1. K. E. Wilzbach, *J. Am. Chem. Soc.* 79, 1013 (1957).
2. R. Wolfgang *et al.*, *ibid.* 78, 2354 (1956).
3. Obtained from Nutritional Biochemical Corp., Cleveland, Ohio.
4. Exposure to tritium gas was carried out by the New England Nuclear Corp., Boston, Mass.
5. J. M. Goncalves, R. Mollinari, H. F. Deutsch, *Arch. Biochem. and Biophys.* 60, 171 (1956).
6. O. Lowry *et al.*, *J. Biol. Chem.* 193, 265 (1951).
7. H. H. Tallan and W. H. Stein, *ibid.* 200, 507 (1953).
8. M. Vaughan, D. Steinberg, J. Logan, *Science*, this issue.
9. Tri-Carb Liquid Scintillation Spectrometer, Packard Instrument Co., La Grange, Ill.
10. Obtained from Armour and Co., Chicago, Ill.
11. We are grateful to K. E. Wilzbach for his kindness in carrying out this tritiation procedure for us.
12. C. B. Anfinsen *et al.*, *J. Biol. Chem.* 207, 201 (1954).
13. C. H. W. Hirs, S. Moore, W. H. Stein, *ibid.* 200, 493 (1953).

12 June 1957

Cerebral Synaptic Inhibition by Serotonin and Iproniazid

In 1955 we (*1*) described the highly potent cerebral synaptic inhibitory action exercised by serotonin. On this basis, we suggested for this natural constituent of mammalian brain a highly important role as a neurohumoral synaptic inhibitor, overshadowing adrenaline and noradrenaline by virtue of its much greater potency.

The action was limited to the brain by the "close arterial" injection into the common carotid artery of the lightly anesthetized cat. Obviously, under these circumstances the serotonin penetrated the blood-brain barrier in order to inhibit the ipsilateral cortical synapses, as was indicated by the reduction in the cortically recorded action potential signaling the evoked response.

We were impressed by the high potency of this action. Serotonin proved effective in doses of as little as 1 μg/kg, and it was 20 times more potent than the next most active natural synaptic inhibitor that we had previously described—namely, adrenaline. The high potency appears to be characteristically cerebral, since the synaptic inhibition we had already recorded in the ciliary ganglion (*2*) required about 75 times the dose. Having dealt only with exogenous serotonin, one could properly ask for a demonstration of the action of endogenous or *in situ* serotonin. We believe that we have given this with the following data.

The action of serotonin is short-lived, because of its great susceptibility to monoamine oxidase (*3*). We reasoned that, if serotonin is naturally present at synapses, we should be able to make its action apparent by inhibiting cerebral monoamine oxidase (MAO), and thereby accumulating *in situ* serotonin until it reaches the threshold for synaptic inhibitory action. This we have done with iproniazid. On intracarotid injection, it reproduces the picture of serotonin action—namely, a reduction of both the evoked responses and the electrocorticogram recorded from the same electrode. As in previous work, we have evoked potentials in the optic cortex of the cat by initiating transcallosal impulses (*1, 4*). That the inhibition of evoked responses and of the electrocorticogram is the result of a poisoning of monoamine oxidase and consequent *in situ* accumulation of serotonin is borne out by the determination of cerebral monoamine oxidase at the time of maximum synaptic inhibition indicated electrically.

The data are displayed in Fig. 1. The monoamine oxidase titer of the injected hemisphere is expressed as percentage of the titer in the opposite or control hemisphere. The evoked potential and electrocorticogram findings are indicated by appropriate symbols at the base of each bar. The left-hand side of the diagram shows the influence of saline control injection. It is evident that there is no change in the electrocorticogram, which was the only electric record taken in this set of controls, and that the variation in monoamine oxidase content of the two hemispheres is relatively small. The extremes of this variation are extended by dotted lines to overlap the right-hand half of the figure, which indicates the data obtained with iproniazid. It is apparent that at the height of synaptic inhibition there is, on the whole, a reduction of monoamine oxidase on the injected side considerably exceeding the natural variations. Similar data were obtained by comparing subelectrode biopsies from the recording hemispheres with the symmetrical points on the opposite sides, but the results were not quite so consistent, probably because of the difficulty in obtaining subelectrode plugs containing identical proportions of the higher monoamine oxidase containing gray matter and the white matter on the two sides.

The direction of these preliminary findings is clear. However, substantiation by further numbers is required to determine whether the instances where electrically indicated inhibition is accompanied by a change in monoamine oxidase titer on the injected side that fails to exceed normal variations are, in fact, due to an initial asymmetrical monoamine oxidase distribution favoring the control side and therefore minimizing the apparent difference induced by iproniazid between the injected and control hemispheres.

This, and the influence of possible leakage across the brain of iproniazid in a few experiments, as well as the safety factor for monoamine oxidase, must be determined. We are now engaged in the final step of simultaneously measuring brain serotonin and monoamine oxidase activity at the time of synaptic inhibition brought about by intracarotid injection of iproniazid.

Since we have shown that many chemical psychotogens are synaptic inhibitors, serotonin or some similar substance seems a likely candidate for the role of an endogenous psychotogen acting by distorting synaptic equilibrium (*5*). That such a distortion could also sometimes be therapeutic is suggested by the recent report of improvement obtained by iproniazid administration in mental disturbance characterized by marked depression (*6*).

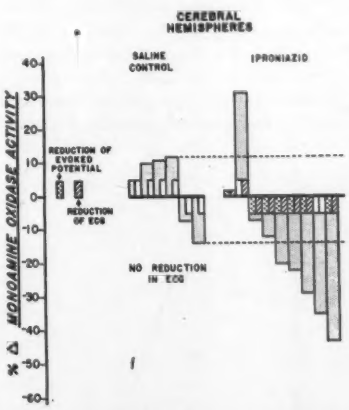

Fig. 1. Correspondence of differential iproniazid inhibition of monoamine oxidase and electric activity in brain. Iproniazid (10 mg/kg) injected into the common carotid artery of a cat anesthetized with sodium pentobarbital.

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References

1. A. S. Marrazzi and E. R. Hart, *Science* **121**, 365 (1955).
2. ———, in I. H. Page and J. W. McCubbin, *Circulation Res.* **1**, 358 (1953).
3. E. A. Zeller and J. Barsky, *Proc. Soc. Exptl. Biol. Med.* **81**, 459 (1952).
4. A. S. Marrazzi, *Science* **118**, 367 (1953).
5. A. S. Marrazzi and E. R. Hart, *J. Nervous Mental Disease* **122**, 453 (1955).
6. J. C. Saunders, N. Radinger, N. S. Kline, *Soc. Biol. Psychiat.*, in press.

2 July 1957

On the Nature of the Pigment in Retinal Pigment Epithelium

Although there have been no biochemical studies of the nature of pigment granules in the retinal pigment epithelium, it has been assumed that the pigment is melanin. This assumption is presumably based on the failure of pigment synthesis in the retinal pigment epithelium of the complete albino. Also, Miescher, in 1923, demonstrated "dihydroxyphenylalanine oxidase" by histochemical methods in the retinal pigment epithelium of the chick, rabbit, and guinea pig (*1*). In some recent manometric studies of homogenates and pigment granules from the retinal pigment epithelium of embryonic chicks, we have demonstrated the presence of the melanin-synthesizing enzyme, tyrosinase (*2*).

The retinal pigment epithelium, derived from neural ectoderm, is a cuboidal epithelium which lies immediately to the outer side of the layer of rods and cones. Pigment granules in human retinal pigment epithelium first appear in the fourth week (5 to 6-mm stage), and by the fifth week (10-mm stage) full pigmentation of the retinal pigment epithelium has occurred. Except for an increase in area, the retinal pigment epithelium remains essentially the same throughout life.

Although retinal pigment epithelium is intimately related to the rods and cones, it is easily separated as a delicate black membrane. Thus it is possible to utilize relatively pure retinal pigment epithelium in enzymic studies with substrates (tyrosine, cresol) that are known

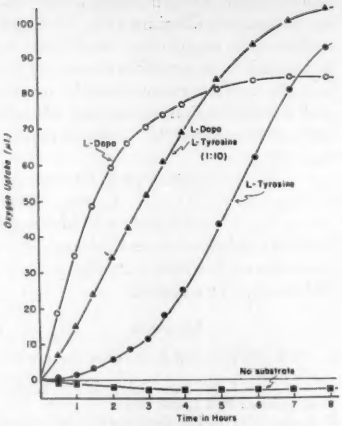

Fig. 1. Enzymic oxidation of L-tyrosine and L-3, 4, dihydroxyphenylalanine (L-DOPA) by homogenates of the retinal pigment epithelium of Rhode Island Red chick embryos. Total amount of substrate, 1.77 µmole.

to form melanin in plants, insects, and chordates (*3*).

For our studies, we used retinal pigment epithelium dissected from eyes of the Rhode Island Red and Black Australorp chick embryos. Homogenates of pigment epithelium from approximately 20 eyes of 9- to 12-day embryos were used in each Warburg flask. In the presence of the homogenates from both species, L-3,4-dihydroxyphenylalanine (L-DOPA) was immediately oxidized without any detectable induction period (Fig. 1. The homogenates catalyzed the oxidation of L-tyrosine only after an induction period which was shortened by the addition of a small amount of L-DOPA (Fig. 1). Four atoms of oxygen and 5 atoms of oxygen were consumed per molecule of L-DOPA and L-tyrosine, respectively. The pigment epithelium homogenates did not catalyze the oxidation of *p*-cresol, catechol, or D-tyrosine. Tyrosinase activity was completely inhibited by the addition of 0.001*M* 4-chlororesorcinol or sodium diethyldithiocarbamate.

By a technique similar to that of Kertesz (*4*), copper was removed by dialysis in the presence of potassium cyanide. The metal-free enzyme was without activity on L-tyrosine or L-DOPA, but addition of trace amounts of copper restored the catalytic activity against L-DOPA but not against L-tyrosine. The failure of the reconstituted enzyme to catalyze the oxidation of L-tyrosine is similar to the behavior of mammalian tyrosinase following removal and addition of copper (*4*). The trace element, copper, which is necessary for formation of melanin, has been found in the retina of mammals, amphibians, and fish (*5*).

A study of pigment granules isolated from the retinal pigment epithelium of Rhode Island Red embryos at different embryonal stages revealed a change in the level of tyrosinase activity during differentiation. Tyrosinase activity was first detectable on the sixth day and gradually increased, reaching a maximum on the tenth day. Enzyme activity fell abruptly after the 12th day, and no tyrosinase activity was present on and after the 14th day of development (Fig. 2).

With a histochemical autoradiographic technique in which DL-tyrosine-2-C^{14} was used as a substrate (*6*), tyrosinase activity was shown to be present in the retinal pigment epithelium of both a C-57 15-day mouse embryo and a 6-month human fetus (*7*). However, no tyrosinase activity was detectable in the retinal pigment epithelium of adult Rhode Island Red and Black Australorp chickens, the C-57 mouse, and the adult human being.

Avian tyrosinase present in the retinal pigment epithelium appears to be similar to plant, insect, and mammalian tyrosinase in its requirement for copper and in exhibiting an induction period in the oxidation of monophenols which can be abolished by addition of small amounts of diphenols (*3*). The specificity of avian tyrosinase for tyrosine and DOPA places it in the class of tyrosinases found in mammalian malignant melanomas (*8*). Plant tyrosinases, being less specific than mammalian tyrosinase, readily catalyze the oxidation of cresol and catechol as well as of tyrosine and DOPA.

It appears from these biochemical studies that the pigment in the retinal pigment epithelium is formed during differentiation by the enzymic oxidation of tyrosine to melanin, catalyzed by tyrosinase attached to cytoplasmic pigment granules. Since avian retinal tyrosinase exhibits some similarities to mammalian tyrosinase present in mouse and human malignant melanomas, it may be useful in elucidating some of the biochemical factors that regulate tyrosinase activity in normal mammalian melanoblasts during differentiation.

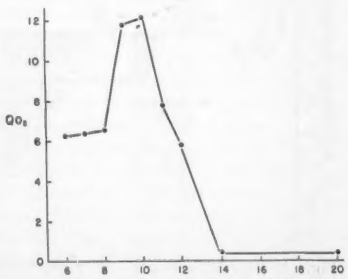

Fig. 2. Changes in tyrosinase activity of melanin granules isolated from the retinal pigmented epithelium of the Rhode Island Red chick during embryonal development.

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References and Notes

1. G. Miescher, *Arch. mikroskop. Anat. u. Entwicklungsmech.* 97, 326 (1923).
2. This investigation was supported by the Damon Runyon Fund and U.S. Public Health Service grant C-2408.
3. H. S. Mason, *Advances in Enzymol.* 15, 105 (1955).
4. D. Kertesz, *J. Natl. Cancer Inst.* 14, 1081 (1954).
5. J. M. Bowness *et al.*, *Biochem. J.* (*London*) 51, 521, 530 (1952).
6. T. B. Fitzpatrick and A. Kukita, *J. Invest. Dermatol.* 26, 173 (1956).
7. A. Kukita and T. B. Fitzpatrick, unpublished data.
8. A. B. Lerner *et al.*, *J. Biol. Chem.* 191, 799 (1951).

29 May 1957

Kojic Acid—a Convulsant

The mode of formation of kojic acid by microorganisms (*1*), its great chemical reactivity (*2*), and the fact that it is further metabolized by microorganisms suggested to one of us (T.E.F.) that kojic acid might be metabolized by multicellular organisms and, perhaps, also by the diabetic animal (*3*). In the dogs studied by him, the intravenous injection of 150 mg/kg of body weight produced a marked toxic response, including convulsions.

In our studies, mice, guinea pigs, and rabbits, as well as dogs, were employed. Three routes of administration were utilized: subcutaneous, peritoneal, and intravenous. Mice were employed in the intravenous survey experiments (to determine the effective convulsive dose) and in the anticonvulsive studies (*4*). Aqueous solutions adjusted to *p*H 7.0 were employed in all experiments and, in the toxicity experiments, all doses were injected within 20 seconds (*5*).

The administration of large doses of kojic acid (1000 mg/kg) to two dogs caused death to both, yet evidence of kojic acid excretion in saliva and urine, even if indirect, was thereby secured. The nonspecific ferric chloride reaction was used. The CD_{50} and the LD_{50} in mice are approximately 350 and 500 mg/kg, respectively.

The gross external manifestations of kojic acid administered to mice, guinea pigs, rabbits, or dogs are generally alike and are similar to the well-known effects of Metrazol.

Because in dogs the toxic manifestations of kojic acid in dosages of 200 to

500 mg/kg are similar in some aspects to the clinical phenomena of epilepsy, the effects in dogs are dealt with in some detail.

Early effects were alike in all the dogs, regardless of dose or route of administration. All appeared irritable and all urinated, defecated, and vomited, and some became restless. Three dogs that were passing into the second stage of action seemed dazed, panted a great deal, and salivated to some extent. Panting and salivation became more marked as the second stage progressed. Walking was associated with head held low, attempts to lie down, and finally a collapse. Feces were mixed with considerable mucus. The remarkable thing about these second-stage dogs was that they recovered several times and seemed to behave normally for intervals of 5 to 10 minutes, after which they again relapsed. In every instance where coma did not develop, symptoms disappeared within 3 hours.

Late stages of toxicity were always ushered in with considerable excitability. Barking, panting, and salivation were very marked. Convulsions of the clonic-tonic type occurred at intervals, between which the dogs seemed stuporous. Continuous salivation and occasional twitching, particularly of the extremities, were observed between the seizures.

Dogs given kojic acid intravenously exhibited a more severe degree of toxicity than those given the acid by another route. None of the dogs died, although the canine that received 500 mg/kg of kojic acid intravenously exhibited a very stormy convulsive stage. All of the dogs given kojic acid intravenously developed third-stage toxicity, and the two dogs given the higher doses of kojic acid had convulsions of the clonic-tonic type. Effects, regardless of the dose, occurred within 15 minutes and, with the largest dose, within 5 minutes. None of the dogs recovered completely until approximately 24 hours after injection, and the dog given the largest dose, 500 mg/kg, was not well for about 48 hours. The dog given the smallest dose of kojic acid intravenously, 200 mg/kg, recovered sufficiently in about 8 hours to drink small quantities of water.

The reaction patterns observed in the dogs given kojic acid subcutaneously and peritoneally were similar to those observed after intravenous administration. What differences were noted could be ascribed mainly to the route.

If the response of the dogs differs in any manner from the manifestations of the other animal species, it is in the retching and vomiting observed early, and in what may be described as intervals of relative normalcy between periods of seizure and later effects. Since deaths, with the doses used, occurred in the other animals and not among the dogs, it is possible that the latter are better able to detoxify kojic acid.

In the evaluation of the protective ratio (PR) of barbital and phenobarbital (50 mg/kg each) by the Orloff method (*4*), kojic acid was substituted for, and compared with, Metrazol. The average dose of Metrazol for a single twitch was 50 mg/kg and for a persistent convulsion, 150 mg/kg. To produce comparable effects with kojic acid took 135 and 400 mg/kg, respectively. Average dosages were obtained from 20 mice weighing 18 to 20 g. The protective ratios are tabulated in Table 1. The ratios for barbital-Metrazol and for barbital-kojic acid are very much alike.

Metrazol is a much more toxic substance per unit weight than kojic acid, for the latter required approximately 400 mg/kg of body weight to produce a persistent convulsion, whereas Metrazol required approximately one-third of this amount. It is of interest to note that when kojic acid was administered to mice in the dose of 400 mg/kg of body weight by way of the rapid infusion technique (effective convulsive dose studies), two out of ten mice died, whereas all recovered from an equal amount of kojic acid administered by the divided-infusion method. The detoxification mechanism probably is given a longer opportunity to act in the divided-infusion method.

Table 1. Evaluation of the anticonvulsive properties of barbital and phenobarbital—comparison of kojic acid and Metrazol. Twenty mice were used in each experiment.

Group	Time (min)	Dose (avg.) for one twitch (mg/kg)	PR for one twitch	Dose (avg.) persistent convulsions	PR for persistent convulsions
Phenobarbital-Metrazol	5	83.00	1.66	240.00	1.60
	60	116.50	2.33	180.00	1.20
	120	100.00	2.00	255.00	1.70
Phenobarbital-kojic acid	5	236.25	1.75	664.00	1.66
	60	337.50	2.5	415.00	1.00+
	120	286.20	2.12	580.00	1.45
Barbital-Metrazol	5	83.00	1.66	195.00	1.30
	60	100.00	2.00	225.00	1.50
	120	66.50	1.33	180.00	1.20
Barbital-kojic acid	5	218.70	1.62	440.00	1.10
	60	270.00	2.00	600.00	1.50
	120	236.25	1.75	420.00	1.00+

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References and Notes

1. K. Saite, *Botan. Mag.* (*Tokyo*) 21, 249 (1907); H. R. V. Arnstein and R. Bentley, *Biochem J.* (*London*) 62, 403 (1956).
2. J. W. Foster, *Chemical Activities of Fungi* (Academic Press, New York, 1948), chap. XVI, p. 458.
3. T. E. Friedemann, *Science* 80, 24 (1934).
4. M. T. Orloff, H. L. Williams, C. C. Pfeiffer, *Proc. Soc. Exptl. Biol. Med.* 70, 254 (1949).
5. Kojic acid for this study was secured from the U.S. Department of Agriculture and from Pfizer and Company.

17 June 1957

Detection of Rare-Earth Ions as Oxalates and Cupferrates

Although a great amount of work has been published on the rare-earth oxalates, little is known about the sensitivity of the reaction between the metal ions and oxalic acid. In 0.5*N* mineral acid medium at 60°C, the sensitivity limit has been set as 700 ppm (*1*). This, however, is for the rare-earth group and not for the individual rare-earth metal ions.

Cupferron (ammonium nitrosophenylhydroxylamine) also forms insoluble precipitates with the rare-earth metal ions (*2, 3*). However, nothing is known concerning the sensitivity of the precipitation reaction.

A modification of the method of Irving, Butler, and Ring (*4*) was used to determine the reaction sensitivity. Tests were conducted in 1- by 6-in. test tubes containing a known amount of the 0.01*M* or 0.001*M* rare-earth metal chloride solution and 0.2 ml of 0.1*M* precipitating agent solution in a total volume of 7.0 ml. The test solutions were heated for 10 minutes at 80°C, allowed to cool to room temperature, and then observed visually for the presence of a precipitate.

Table 1. Results of sensitivity tests.

Rare-earth ion	$H_2C_2O_4$ (M^{+3} μg/ml)	Cupferron (M^{+3} μg/ml)
Lanthanum	6.3	2.4
Cerium (III)	6.4	1.6
Praseodymium	6.4	1.6
Neodymium	6.6	2.5
Samarium	6.9	5.1
Gadolinium	17.8	17.8
Yttrium	10.2	10.2

The results of the sensitivity tests are given in Table 1. In general, cupferron appears to be a more sensitive reagent for the detection of the metal ions than oxalic acid. The sensitivity of the oxalic acid tests are greater than those previously found (*1*) but this is perhaps attributable to the absence of a mineral acid. The sensitivity of both reagents decreases with an increase in metal ion atomic number.

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References

1. G. Charlot, D. Bézier, R. Gauguin, *Rapid Detection of Cations* (Chemical Publishing Co., New York, 1954), p. 59.
2. A. I. Popov and W. W. Wendlandt, *Anal. Chem.* 26, 883 (1954).
3. W. W. Wendlandt, *ibid.* 27, 1277 (1955).
4. H. Irving, E. J. Butler, M. F. Ring, *J. Chem. Soc.* 1949, 1489 (1949).

14 May 1957

Blood Groups in Pituitary Adenoma—"Suspected Correlation" Reexamined

Mayr, Diamond, Levine, and Mayr (*1*) have recently presented data on ABO blood groups in 123 patients with chromophobe adenoma of the pituitary gland. Of these patients, 57 were from three Boston hospitals and 66 from two hospitals in New York City—23 from the New York Hospital and 43 from the Presbyterian Hospital. Boston and New York patients alike showed marked deviations—more group O, less group A—from the distributions (i) estimated for the total Boston population and (ii) found among 637 Boston patients with brain tumors other than chromophobe adenoma. Distributions i and ii were virtually identical. When the Boston brain-tumor patients were compared with all 123 patients with chromophobe adenoma, the χ^2 test gave a p value < 0.001, but when they were compared with the 57 Boston adenoma patients, $0.02 > p > 0.01$ (my calculation).

Mayr *et al.* wisely considered their findings as tentative, in view of the smallness of their pituitary adenoma sample, despite the statistical significance of the deviation and the concordance of data from four of the five hospitals.

Their investigation has been extended for two reasons. A previous compilation (*2*) on a larger sample of Presbyterian Hospital patients with chromophobe adenoma of the pituitary had shown a blood group distribution unlike that of Mayr *et al.* from the same hospital and one which, in fact, did not differ from that of the Presbyterian Hospital as a whole (*3*). Moreover, the adequacy of a Boston population as a control can be questioned, in view of the high proportion, in certain New York hospitals, of Negroes, with a greater than 2 to 1 preponderance of blood group O over A (*4*), and in view of the different ancestry of the Boston and New York white populations. Not only cities but hospitals within a city and even services within the same hospital may vary widely in genetic composition. It was therefore decided to review (*5*) all cases of chromophobe adenoma at the Presbyterian Hospital for the past 20 years, as far back as records are readily available, and to compare their ABO incidence with that for the Presbyterian Hospital as a whole. This was based on all persons (2259 in number) who received blood transfusions during a 6-month period in 1953. Although the hospital population may have changed over the 20-year period, the transfusion series was deemed an adequate control group for the purpose.

After exclusion of mixed chromophobe and eosinophilic adenomas and of cases where the diagnosis was doubtful or where a microscopic tumor was encountered incidentally at autopsy, 321 cases of adenoma were found. The diagnosis rested on tissue examination or on firm clinical grounds (including enlarged sella turcica, encephalograms, endocrinological and visual abnormalities, and response to x-ray therapy), or on a combination of the two. Of the 321 patients, blood had been typed in 203. There was no difference in ancestry between those who had and those who had not blood-group determinations ($p = 0.60$) or in blood-group frequencies between the 132 with and the 71 without tissue diagnosis ($0.05 > p > 0.02$). The patients with blood-group determinations included 18.2 percent Jews, 7.4 percent Italians, 46.4 percent other whites, and 17.2 percent Negroes. Corresponding figures for the "transfusion group" were quite comparable—16.1 percent, 5.7 percent, 60.0 percent, and 16.4 percent.

In ABO frequency (Table 1), neither whites, Negroes, nor the adenoma series as a whole, which also included eight Puerto Ricans, ten other Latin Americans, and one Chinese, differed from the corresponding "transfusion" group. Chi-square tests gave the respective p values of 0.40, 0.40, and 0.60. While there was a slight percentage preponderance of group O and deficit of A, it is not permissible statistically to compare such subtotals when the complete distributions do not differ (*6*). Neither the total Presbyterian Hospital adenoma series nor the white subgroup within it differed from the Boston brain-tumor series of Mayr *et al.*—p values are 0.25 and 0.40, respectively. Thus, a sizable Presbyterian Hospital series affords no basis for the "suspected correlation" between blood-group frequency and pituitary adenoma.

Should a comparable anlysis of the New York Hospital data yield similar results—a not unreasonable supposition—the "suspected correlation" would rest solely on a probability, based on 57 Boston patients, between the 1-percent and 2-percent significance levels—far from the 0.001 level recommended by Fraser Roberts (*7*) for blood-group correlations.

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Table 1. ABO blood groups in Presbyterian Hospital patients receiving blood transfusion and those with chromophobe adenoma of the pituitary.

	Blood group								
	O		A		B		AB		Total
	No.	%	No.	%	No.	%	No.	%	No.
Whites									
"Transfusion group"	802	43.4	751	40.6	213	11.5	82	4.4	1848
Adenomas	71	47.3	50	33.3	21	14.0	8	5.3	150
Negroes									
"Transfusion group"	187	50.5	101	27.3	67	18.1	15	4.0	370
Adenomas	20	58.8	8	23.5	6	17.6	0	0	34
Total series									
"Transfusion group"	1011	44.5	865	38.3	286	12.6	97	4.6	2259
Adenomas	101	49.8	66	32.5	28	13.8	8	3.9	203

References and Notes

1. E. Mayr *et al.*, *Science* **124**, 932 (1956).
2. A. Damon, unpublished study.
3. This was determined by John Scudder and R. H. Osborne, who kindly allowed access to their unpublished data and permission to quote.
4. E. B. Miller, R. E. Rosenfield, P. Vogel, *Am. J. Phys. Anthropol.* **9**, 115 (1951).
5. This work was done during the tenure of a research fellowship of the American Heart Association.
6. D. Mainland, *Elementary Medical Statistics* (Saunders, Philadelphia, Pa., 1952), pp. 142–143.
7. J. A. Fraser Roberts, *Proc. Roy. Soc. Med.* **48**, 143 (1955).

20 May 1957

The deviations from the control group found by Albert Damon for a sample of 203 patients with chromophobe adenoma of the pituitary are smaller than those found by Mayr *et al.* in smaller Boston samples. They are, in Damon's sample, for group 0, +9 percent among whites and +16 percent among Negroes, and for group A, −18 percent among whites and −14 percent among Negroes (controls = 100 percent). Yet it is gratifying to learn that the direction of all of these deviations is exactly the same as that found in the Boston samples, even though in this rare disease it is difficult to obtain sufficiently large samples to substantiate the significance of the deviations statistically.

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Standard Human Beings versus Standard Values

A fact which is highly pertinent to the thinking of many scientists has received very little or no attention in the application of statistical methods to the study of human beings—namely, that the expected number of individuals in any standard group diminishes, and may diminish greatly, when a *series* of measures is applied. If one uses as standards (i) the medial 50 percent, (ii) the medial 95 percent, or (iii) the medial 99.8 percent, the fractions of a given group that remain after specific numbers of independent measures are shown in Table 1.

In our thinking, we often carry the concept of "standard" or "normal" individuals. If such a "standard individual" means one who is in the medial 50-percent range in every measurable way, then, making the simplifying assumption that only ten independent measurable items exist, we must arrive at the conclusion that only one person in 1024 is "standard." Seldom are there published data which are sufficiently detailed so that this idea can be applied. However, such data are to be found in an article entitled "Plasma lipids of normal men at different ages" (*1*).

There are 65 individuals for whom complete data are given with respect to seven items: (i) total lipid C, (ii) total lipid P, (iii) total lipid N, (iv) lipid amino N, (v) total cholesterol, (vi) free cholesterol, and (vii) esterified cholesterol, each present in 100 ml of plasma. Selection of the medial 50 percent of the individuals after each measurement yields the results given in Table 2. If the measures were independent ones (which they obviously are not), the number remaining in the medial group would have been two after five measures instead of after seven measures, as in this actual case. On the basis chosen, two individuals out of 65 turn out to be standard with respect to the seven somewhat related measures.

If we wish to think of a standard individual in terms of the medial 95 percent with respect to every measurement (making the assumption that there are only ten measurable items), we find that about six out of ten individuals are standard. If, however, we do not make this simplifying assumption and recognize that human beings are of such complexity that hundreds of relatively independent measures are possible (anatomical, histological, physiological, pharmacological, biochemical, psychological, and so on), we are faced with the fact that even in a large sample every individual may be nonstandard with respect to some of the measures in which we may choose to be interested, even at the 95-percent level under consideration. We certainly could not expect any randomly selected individual to be standard in terms of our initial definition.

If we choose to expand our concept of "standard individual" to include the medial 99.8 percent, we will be able to find a substantial number of individuals who are standard, even though many independent measures are made. Some have assumed that selection of 99.8 percent as the standard would result in the exclusion of only 200,000 individuals from a population of 100 million (roughly the adult population of the United States) (*2*). Actually, however, approximately this many are excluded by *each* successive measurement, so that on the basis of 100 measurements, about 18 million would be excluded. If we make the conservative assumption that only 100 measurable items exist for each individual human being, there is about one chance in five that a randomly selected individual will be nonstandard with respect to some of the items, even on the 99.8-percent basis. The use of the concept of a standard man (in contrast to the search for standard values) thus becomes difficult to justify on any definitive basis. If we expand our concept to encompass practically the whole of the population, then the usefulness of the standard vanishes.

Table 1. Results of successive independent measures.

Size of medial group (%)	No. of measures	Fraction of original group remaining in medial group
50	1	0.50
50	5	0.03
50	10	0.001
95	1	0.95
95	10	0.60
95	15	0.468
95	100	0.0059
99.8	1	0.998
99.8	10	0.98
99.8	100	0.82

There are many areas where the afore-mentioned ideas are applicable and where the concept of standard individuals is inherent, whether or not it is overtly expressed. The one which comes closest to the field of my professional competence is that of nutrition. The Food and Nutrition Board and the U.S. Food and Drug Administration have set up "Recommended daily allowances" and "Minimum daily requirements," respectively, for standard or normal human beings. At the present time, 12 items are included in these lists; as further information becomes available, these lists will be expanded. The "recommended allowances" are, in general, more generous than the "minimum daily requirements" and are designed to be "suitable for the maintenance of good nutrition in essentially the whole population."

The point which our data (*3*) emphasize is that, if the level for each nutrient is satisfactory for a specified percentage of the population, the levels *taken as a group* would be satisfactory for a smaller percentage. If 12 levels are individually satisfactory for 90 percent of the population, the 12 levels taken as a group (on the assumption that they are independent of one another) would be satisfactory for only about 28 percent of the population. These needs are not completely independent of one another; hence, the 28-percent figure is low by an unknown amount. As the number of items on the list increases, the discrepancy between the validity of the indi-

Table 2. Size of medial 50-percent group after successive measurements.

Number of measures	1	2	3	4	5	6	7
Individuals in medial group	33	21	14	10	8	3	2

vidual items and their validity as a group increases.

The principle which we have pointed out in connection with the nutritional example applies whenever the concept of standard or normal human beings is used. Does not a substantial amount of our scientific thinking involve this questionable concept?

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References and Notes

1. I. H. Page *et al.*, *J. Biol. Chem.* 111, 613 (1935).
2. D. Wechsler, *Range of Human Capacities* (Williams and Wilkins, Baltimore, Md., 1952), p. 86.
3. This study is a contribution from the Clayton Foundation for Research, the Biochemical Institute, and the Department of Chemistry, University of Texas, Austin.

12 June 1957

Membrane Time Constant of Motoneurons

New information about motoneuron membranes has been obtained in recent experiments in which intracellular electrodes were used for both stimulation and recording at the motoneuron soma (*1–6*). Unexpectedly low membrane time-constant values have been inferred from the subthreshold transients of membrane potential observed when constant current was applied across the soma membrane (*2–4*). It is shown in this report, however, that these experimental transients are theoretically consistent with significantly larger membrane time-constant values, provided that the cablelike properties of dendrites are taken into account. This correction removes the apparent discrepancy (*3–5*) between the soma membrane time constant and the time constant of synaptic potential decay and thus removes the need for special explanations, such as a hypothetical prolongation of synaptic depolarizing activity (*4, 6*), or a prolongation of soma synaptic potential by electrotonic spread from a larger and slower synaptic potential postulated to occur in the dendrites (*5*).

The membrane time constant τ is defined as the product of passive membrane resistance and capacitance. The assumption (*2–4, 6*) that the experimentally observed membrane transients may be regarded as exponential curves having this time constant τ would be valid only if constant current were applied uniformly to the entire membrane surface. For the experiments in question, this could be true only for the hypothetical case of a *soma without dendrites*. The lower dashed curve in Fig. 1 illustrates the exponential time course of membrane potential change V, relative to its final steady value V_s for this hypothetical case.

Since the motoneurons are known to possess several large dendrites, a significant portion of the current applied to the soma must spread (electrotonically) along these several dendrites. This will change the time course of soma membrane potential. For example, as the size and number of dentrites is increased relative to soma size, there is a limiting case, *dendrites without soma*. This case is illustrated by the upper dashed curve in Fig. 1, on the assumption that these dendrites have the same membrane time constant τ and that they may be represented as cylinders of infinite length. This time course can be precisely expressed as

$$V/V_s = \operatorname{erf}\sqrt{t/\tau}$$

for the membrane potential at the point (soma) where constant current is applied across the membrane of each dendrite. It is the same as that obtained in the more familiar problem of electrotonic potential beneath an electrode ($x = 0$), when constant current is applied between external electrodes placed far apart on a cylindrical axon (*7*). This curve is not a simple exponential: the time required to reach half of the steady value V_s is one-third of the time required in the lower dashed curve, while the time required to reach 90 percent of V_s is about three-fifths of that required in the lower dashed curve.

The middle curve in Fig. 1 corresponds to an intermediate relation between dendrites and soma (*8*). It has been assumed that soma and dendrite membranes have the same membrane time constant and that the membrane potential at any moment is uniform over the soma surface (*9*), up to and including the origins of the dendrites. The dendrites can be treated either as cylinders of infinite length or as structures which taper and branch exponentially.

This intermediate curve was calculated with a value of 5 for the ratio between the steady-state membrane current drawn by the dendrites and the steady-state current drawn by the soma membrane. This value is theoretically consistent with the specific example of a soma with six cylindrical dendrites (used in *1* and *6*, as well as in *3*), provided that a value of about 2000 ohm cm² is used for the membrane resistivity. Since this example probably underestimates the size and number of dendrites (*1*, p. 322), it is predicted that the time course of soma membrane potential change, when constant current is applied to the soma, will lie *between* the two upper curves in Fig. 1, for many motoneurons.

On the basis of this theoretical prediction, the membrane time constant can be estimated as being the time required for the experimental transients to reach about 82 percent of the final steady value. Since, however, the experimental

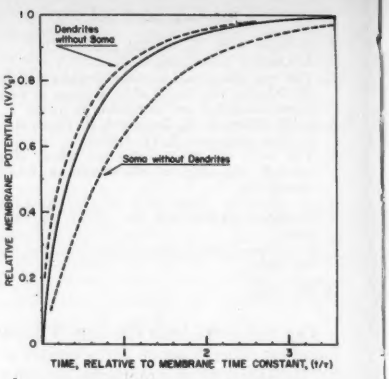

Fig. 1. Membrane potential transients at the neuron soma and origins of dendrites, when constant current is applied across the soma membrane.

error permits exponential curves to be fitted to the experimental transients (*2–4*), it should be noted that the time constants of such curves can be expected to be smaller than the actual membrane time constant, by a factor of about 2. It appears, therefore, that these experimental transients do not conflict significantly with the earlier estimate (*10*), of about 4 msec for the membrane time constant of cat motoneurons, which was based on the decay time constant of synaptic potentials (*10*) and of monosynaptic facilitation (*11*).

This is consistent with the simple notion of synaptic potential decay as a purely passive process, having the same characteristics on both soma and dendrites (*12*).

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References and Notes

1. J. S. Coombs, J. C. Eccles, P. Fatt, *J. Physiol.* 130, 291 (1955).
2. T. Araki and T. Otani, *J. Neurophysiol.* 18, 472 (1955).
3. K. Frank and M. G. F. Fuortes, *J. Physiol.* 134, 451 (1956).
4. J. S. Coombs, D. R. Curtis, J. C. Eccles, *Nature* 178, 1049 (1956).
5. P. Fatt, *J. Neurophysiol.* 20, 61 (1957).
6. J. C. Eccles, *The Physiology of Nerve Cells* (Johns Hopkins Press, Baltimore, Md., 1957).
7. A. L. Hodgkin and W. A. H. Rushton, *Proc. Roy. Soc. (London)* B133, 444 (1946); L. Davis, Jr., and R. Lorente de Nó, *Studies Rockefeller Inst. Med. Research* 131, 442 (1947).
8. A report of the mathematical treatment of this intermediate problem is in preparation.
9. W. Rall, *Proc. Univ. Otago Med. Sch.* 31, 14 (1953), and abstract for National Biophysics Conference (1957).
10. L. G. Brock, J. S. Coombs, J. C. Eccles, *J. Physiol.* 117, 431 (1952).
11. D. P. C. Lloyd, *J. Neurophysiol.* 9, 421 (1946).
12. The opinions expressed in this note are my own, and are not to be construed as official or as reflecting the views of the U.S. Navy Department or the naval service at large.

31 May 1957

Book Reviews

Wing Theory. A. Robinson and J. A. Laurmann. Cambridge University Press, London, 1956. 569 pp. Illus. $13.50.

So far as I can recall, this is the only textbook or treatise in this important field of fluid mechanics that has appeared in 20 years. It is closer to 30 years, in fact, since Glauert's well-known *Aerofoil and Airscrew Theory* was first published. The present work may be the modern counterpart of Glauert's book—from the same publisher, incidentally—and, if so, the difference in size (a factor of roughly 2.5) probably represents the increase of scope of what we call "wing theory" during these 30 years. For in these days wings are expected to operate not only at low speeds, where compressibility of the air is negligible, but also at high subsonic, transonic, and supersonic speeds as well. This is a book concerned with wings in all of these speed regimes. It is intended as a textbook for advanced courses, and "more generally, for all those . . . who are interested in aerofoil theory for either practical or theoretical reasons."

It begins with a well-written, 80-page, introductory chapter called "Foundations." Here the basic ideas of fluid mechanics are reviewed, and the standard approximations of wing theory are set in their proper relation to the phenomena of real, viscous gas flows: turbulence, boundary layers, and so forth. We then proceed to chapters on two- and three-dimensional wing theory for incompressible steady flow, airfoils in compressible steady flow, and airfoils in unsteady motion. The scope is ambitious; for example, cascades of airfoils are treated, and wind-tunnel wall interference is discussed as well. Hodograph methods, transonic similitude, and reverse-flow theorems are all presented, at least briefly. Shock waves are discussed, and the shock relations are treated in detail. In connection with the matter of profile drag and its experimental determination, even the Karman-Pohlhausen boundary-layer theory is brought in.

Throughout the book, the mathematical treatment is relatively elegant and complete and sometimes a bit formal. Nevertheless, it is always accompanied by clear and sound explanations of the physical situations. There is no attempt, such as is sometimes made, to reduce wing theory to a branch of mathematics. Nevertheless, I do have an impression that at times the elegance and mere length of the mathematical development may obscure the subject, and some of my graduate students who have used the work confirm this. The index seems admirably complete, and the authors' knowledge of the literature of fluid mechanics is truly impressive. References are always included in the text, and in addition there is an extensive appended bibliography.

In summary, I feel secure in recommending this new book as a reference book for many research workers and engineers. The expanding aeronautical industry has recruited many of its research and development personnel from other branches of engineering, physics, and mathematics, and from among young aeronautical engineers who have not progressed very far in modern aerodynamics. These people would do well to study this book. As a textbook for graduate students it may suffer from the elaborate detail of the mathematical presentation. Nevertheless, in some aeronautical programs, wing theory practically replaces fluid mechanics because of time limitations. Where this occurs, the present textbook might well be recommended, since its viewpoint is so broad. It will not, I think, produce "handbook engineers."

W. R. Sears

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Actions Chimiques et Biologiques des Radiations. vol. II. M. Haïssinsky, Ed. Masson, Paris, 1956. 221 pp. Illus. Cloth, F. 3400; paper, F. 2800.

The first volume of this series included three papers in radiobiology, by L. H. Gray, M. Lefort, and W. M. Dale, respectively, on "Physical aspects of radiobiology," "Radiation chemistry of aqueous solutions," and "Modern trends in radiation biochemistry."

In volume II some very fundamental subjects, less well known and understood by biologists and medical practitioners, are presented: "Chemical effects produced by ionizing radiations in the gaseous phase," by W. Mund; "Phenomena of luminescence induced by high-energy radiations," by M. Ageno; and "Introduction to radiation dosimetry," by N. Miller.

By some standards, especially that of a teacher, the order of presentation is somewhat peculiar, in that most instructors and writers prefer to progress from physical aspects to physicochemical aspects, to dosimetry, and thence to radiation biology. There is, however, much to be said for an order of progression, when one is writing for students of a specific regimen, such as biologists and physicians, in which one might develop the lectures from better known to lesser known material, thus enlarging and deepening the understanding. This seems to be the approach used in these volumes.

In volume II, as in volume I, the authors have made a real effort to show the evolution of the three fields from observation of the phenomena, to measurement, to utilization of the specific information in practical problems. Considering this, the reader loses the feeling that a somewhat unorthodox presentation has been given in the volume, and the impression is created that a cooperative effort is being made to consolidate knowledge for application in the problem of how high-energy radiations bring about their effect in biological material.

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The Life of Bacteria. Their growth, metabolism, and relationships. Kenneth V. Thimann. Macmillan, New York, 1955. 775 pp. Illus. $13.50.

Lengthy gestation is frequently associated in folk literature with a remarkable competence on the part of the newly born. Considered, then, against a background of the case histories described by François Rabelais, it is not particularly surprising to learn that Kenneth Thimann's exceedingly competent creature was 15 years *in utero*!

The Life of Bacteria presents, with a rare literary and scientific skill, a superb summary of general microbiology as that burgeoning field exists at mid-century. What emerges from this presentation is not only an outstanding advanced textbook in general microbiology but also an image of the cultured scholar-author, which appears all too infrequently in this age of terse, expository "scientific" writing.

Naturally, in a domain as vast as general microbiology, it is easy to find fault with the particular prejudices and interests of a writer, which are then interpreted as grievous over- or underemphases when scrutinized by the reviewer. In

this sense, then, two of the presently active frontiers of general microbiology—cytology and genetics—are given scantier treatment than seems desirable; on the other hand, while the current frenetic activity in microbial physiology is accurately mirrored, one could wish for fewer details. In a similar vein, a medically oriented colleague has expressed his own dissatisfaction with the somewhat less than a once-over-lightly approach in his special field of infection and immunity. However, there is no point in dismembering a functioning organism because it does not fit a preconceived picture; instead, let us look at the actual presentation.

Thimann's book is "an attempt not only to see bacteriology as a whole—that is, as a branch of biology—but also to see it in its perspective as a development from the past and as an active area of modern investigation." It is a successful attempt, organized in four parts: "Morphology and general physiology"; "Nitrogen cycle"; "Carbohydrate metabolism"; "Growth and synthesis." The text begins with a fascinating history of microbiology. Chapter II outlines the relationship of bacteria to other microorganisms. Internal structure is then considered, followed by a summary of physiology. "Using the term soil in its most general sense, to include also natural waters," Thimann then introduces the roles of microbes in their natural habitat.

Nitrogen metabolism is treated competently in a series of chapters on proteolysis, amino acid catabolism, nitrogen fixation, and nitrification and denitrification.

The section on carbon metabolism includes separate chapters on alcoholic, lactic, propionic, formic, and butyric fermentation, "oxidative fermentations," disaccharide and polysaccharide breakdown, and fermentations involving inorganic hydrogen acceptors. In each case, digressions to related subjects are skillfully made; thus, for example, rumen microbiology is covered in the chapter on polysaccharide breakdown; vinegar manufacture and aromatic catabolism, in the chapter on "oxidative fermentations"; and the significance of Enterobacteriaceae, in the chapter on formic fermentation.

The fourth division begins with growth and protoplasm formation, followed by chapters on assimilation, autotrophy, photosynthesis, and growth inhibition. The final chapter, on evolution, closes the presentation with the significant comment that bacteria "offer an outstanding example of the evolutionary success which attends upon versatility. Perhaps it is because of this versatility that, though they have been so intensively studied, they remain so profoundly unknown."

The text is unstintingly illustrated by photographs, graphs, charts, and drawings and by tables and formulas, both mathematical and chemical. It is admirably indexed, not only by author and subject, but (*mirabile dictu*!) also by microorganisms. Relevant literature is copiously cited, with particular attention given to original papers, which the author (and I concur) feels give "more insight into a subject than the coverage of twenty times as much literature through reviews."

Thimann's work is obviously a labor of love; it illustrates beautifully the beneficial effects of this motivation and the full maturity which is its invariable companion.

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Changes of State. A mathematical-physical assessment. H. N. V. Temperley. Cleaver-Hume, London; Interscience, New York, 1956. 324 pp. Illus. $7.50.

The subject "changes of state," or phase transitions, is amenable to treatment by two of the exact mathematical branches of physics—thermodynamics and statistical mechanics.

The treatment by thermodynamics is rigorous and leads to a natural classification of the various transition types. It also leads to equations which are numerically applicable to experimental data. The results, however, are meager, and a book dealing only with the thermodynamic equations, unless burdened with many numerical examples, would be but of pamphlet length. This treatment occupies Temperley's first chapter.

Statistical mechanical treatments of phase change have not as yet met simultaneously all three criteria of being realistic, rigorous, and numerically applicable. Some treatments manage to satisfy two of these requirements: at least one is rigorous and treats a realistic model but does not lead to numerically applicable equations; one is rigorous and numerically applicable but deals with a model divorced from that of any real material; others treat a reasonably realistic model nonrigorously and arrive at approximate numerical results; most of the rather voluminous literature cannot even be said to do as well as meet even a pair of these three desiderata. A book presenting these mathematical treatments fully could be faultless but would probably be boring.

However, whereas thermodynamics is noncausal in character, statistical mechanical treatments do give some insight into the causes of transitions. An imaginative scientist studying the literature cannot help but arrive at intuitively based conceptual schemes which correlate, in his mind at least, the causes and effects. Such schemes are difficult to convey adequately. Intuitive concepts demand semantic adjectival phrases which tend to escape rigorous definition. A too pedantic caution in definition of terms robs the description of vigor, but an undefined term can be misunderstood, and the description conveyed to the reader may then be merely false.

Temperley's book is outstanding in its wealth of intuitive descriptions. Most chapters start with a verbal explanation, lacking equations, of the subject matter treated. This frequently occupies as much as, or more than, half of the page space. The more important mathematical methods are then given, or at least outlined, and with continuous reference to the original articles. The references, in general, are adequate and well chosen, although in a few instances I felt that more recent references, which often give treatments superior to the original ones, should not have been omitted.

Most readers will probably like or dislike this book, depending on their reaction to the more verbal and intuitively derived concepts. For the value of these it is difficult to give a just and unbiased appraisal. I found some for which I presumably failed to grasp the intent of the author, and for which the arguments appeared therefore to be *non sequiturs*. In a few cases, even, a reasonable interpretation of the terms used seems to lead to a demonstrably false statement. However, many, or most, of the discussions were stimulating and enlightening. A purely critical reader will probably object to the book. One who also has some tolerance of understanding and imagination can find much of value in it.

JOSEPH E. MAYER
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The Neurohypophysis. Proceedings of the eighth symposium of the Colston Research Society, held in the University of Bristol, 1956. H. Heller, Ed. Academic Press, New York; Butterworths, London, 1957. 275 pp. Illus. $9.50.

An increasing appreciation of the true physiological role of the neurohypophysis, together with the fact that two of its active principles have been analyzed chemically and even synthesized, has resulted in renewed interest in this structure—an interest that is reflected by the fact that the eighth symposium of the Colston Research Society (9–12 Apr. 1956) was devoted to it and that the proceedings were published in book form.

Previously, there has been more interest in the adenohypophysis, whose principles produce a variety of dramatic effects and whose deficiency syndrome leads to disability and even death. By contrast, the principles of the neurohypophysis have been considered of more pharmacological than physiological interest, with their deficiency resulting in little more than an inconvenient polyuria. It is becoming more and more apparent, however, that the neurohypophysis, by itself, plays a vital role in fluid and electrolyte balance and in certain aspects of reproductive physiology, and that, by exerting important controls over the adenohypophysis, it is intimately concerned with many of the latter's functions as well. In the introduction to this symposium, by Henry Dale, we are reminded that, recent as much of the interest in the neurohypophysis may seem, historically it was one of the first structures that was ever demonstrated to contain a potent hormone, and that among the very first successful applications of hormone replacement therapy was the use of posterior pituitary powder in the treatment of diabetes insipidus.

The participants in the symposium constitute a distinguished group of investigators—anatomists, biochemists, physiologists, and pharmacologists—gathered together from widespread portions of the globe. The subjects covered at the meetings included the phenomenon of neurosecretion (Bargmann, Hanström); chemistry of the hormones and related substances (Acher and Fromageot, Croxatto); the problems of hormone storage, liberation, destruction, and urinary excretion (van Dyke, Adamsons, and Engel; Heller; Noble); physiological control over hormone release (Ginsburg and Brown, Andersson); pharmacological stimulation (Walker); and, finally, the action of the hormones on such target organs as the kidney (Brooks and Pickford; Sawyer; Wirz), mammary gland (Cowie and Folley), uterus (Fitzpatrick), and adrenals (Gaunt, Lloyd, and Chart; Jones). Every paper is followed by a transcript of the discussion, and many of the participants in the symposium who did not actually deliver papers are heard from in this manner.

As can be seen, these contributions are no miscellaneous collection but comprise an orderly and thorough coverage of the subject, ranging from the most recent theories on the site of formation of the posterior pituitary hormones to observations concerning their ultimate action on various target organs. Each paper includes a pertinent review of the subject, followed by the more recent work of the investigator, so that, in its entirety, this book offers a complete view of research on the neurohypophysis at a rather advanced level. References are well documented, both in papers and discussion. The material has been carefully edited by H. Heller, and the resulting volume has been attractively published and bound. It furnishes a great deal of useful information, much of it new, and at the same time leaves the reader with a keen appreciation of the considerable gaps in present knowledge and the formidable difficulties still to be overcome in this field.

Although the book is quite comprehensive, one might have wished for some coverage of the histochemistry and electron microscopy of the neurohypophysis and for more attention to its possible hormones other than vasopressin and oxytocin, such as that which induces the anterior pituitary to release adrenocorticotropic hormone. In general, this book can be strongly recommended to research workers in physiology or endocrinology, where it will serve as an important reference work for some time to come.

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Technique of Organic Chemistry. vol. X, *Fundamentals of Chromatography*. Harold G. Cassidy. Interscience, New York, 1957. xvii + 447 pp. Illus. $9.75.

The staggering amount of published literature in the field of chromatography makes it unlikely that a single author could do justice to all the various aspects of the subject in a 447-page volume. Cassidy has therefore wisely restricted himself to the principles of the method. This book is not a revision of the author's earlier work, *Adsorption and Chromatography* (volume V in the same series), but a new book.

Starting with a definition of chromatography, the author gives a few examples of chromatographic methods and then discusses the molecular interactions on which the separations are based. This discussion is very brief and should be supplemented by readings from chapters I to V of *Adsorption and Chromatography*. The general theory is then very lucidly explained by the author, who uses the approach from cascade-type distribution, which in my experience is most readily understood by beginning students. This is followed by some details of gas-liquid and liquid-liquid (column and paper) partition chromatography, adsorption and ion-exchange chromatography, and some technical suggestions. The book contains a number of valuable tables of adsorbents, filter papers, and ion exchangers and 1042 references. There is also an appendix of (almost exclusively) American and British supply houses.

The author will undoubtedly succeed in giving the novice an introduction to the principles of chromatography. However, compared with other available books on this subject, the book will be of little value to either the uninitiated who is looking for a definite solution to a separation problem or to the specialist who needs a good bibliography. The illustrations of apparatus are outmoded and inadequate, and the choice of sample techniques and references is inept. Thus, no mention is made, for example, of the English translation of Cramer's book on *Paper Chromatography* or of Trapnell's treatise on *Chemisorption*, and we find only five references to general quantitative methods, one of which is to the *Manual of Paper Chromatography and Paper Electrophoresis* by Block, Durrum, and Zweig, and two to unpublished work of Shapiro and Dowmont. The author devotes a whole chapter to his own work on redox resins, although they have not yet been shown to be applicable to chromatographic separations, but chelating resins are omitted from the text.

Cassidy defines chromatography as "a separation process applicable to essentially molecular mixtures, which relies on distribution of the mixture between an essentially two-dimensional, or thin, phase and one or more bulk phases, which are brought into contact in a differential countercurrent manner." This definition, contrary to that of Strain, includes the relatively uninteresting foam and emulsion fractionation, to which he devotes an entire chapter, but excludes electrochromatography, which is of great importance to biological chemists. The author apparently realizes the dilemma created by his definition when he puts quotation marks on the "surface" of ion exchangers (page 15). The adsorption chromatography of gases is not discussed at all. Chromatostrip and chromatobar are classed with column or paper partition, although they depend on adsorption.

In spite of the limitations of this book, I feel that it will be a valuable aid in the orientation of newcomers to chromatographic methods.

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Man into Space. New projects for rocket and space travel. Hermann Oberth. Translated from the German by G. P. H. De Freville. Harper, New York, 1957. xiv + 232 pp. Illus. $4.50.

Hermann Oberth may be considered the Charles Darwin of rocketry. His first book, in 1923, clearly forecast many of our modern developments, and *Man into Space* starts from today and goes into

the foreseeable future, when mankind will no longer be satisfied with the solar system but will look to the stars.

This book is divided into two parts. The first part is a lively and optimistic description of the training of spacemen, of satellite rockets, and of the space station that permits space travel to the moon and the planets of the solar system. Discussions of the space mirror as a power source and of a "moon car" for getting around on a low-gravity body are indications of the practical turn of the author's mind. The descriptive detail is clear, and engineering development on such concepts could begin today, if it has not already been started! The second part of the book contains a mass of scientific and engineering data supporting and illustrating various points developed in the first part.

It would be a mistake to assume that Oberth is not aware of the difficulties of space travel and its attendant problems. He describes the difficulties inherent in the new type of environment and the changes that must be made in order that men may live (in vehicles) and move where lack of air and low gravity are predominant factors. He always suggests various ways of satisfactorily solving these problems. He emphasizes the importance of the step rocket and of space stations as necessary prerequisites for travel to the moon and the planets. Until more knowledge is obtained about gravity and the nature of "space" itself, man is limited to chemical, and possibly atomic, fuels, and his mode of propulsion must be based on the third law of Newton. Thus, a suitable, low-mass heat source that can be controlled is absolutely necessary. Tomorrow may bring more efficient fuels or methods of propulsion that may not require the orbital space station, but today this is the only practical way of getting into space.

Oberth's whole philosophy is summarized in his last two lines in the descriptive part of his fascinating little book, as follows: "This is the goal: To make available for life every place where life is possible. To make inhabitable all worlds as yet uninhabitable, and all life purposeful." Surely this is a large enough goal for intelligent man!

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New Books

The Rise of Modern Physics. G. F. Von Weizsäcker and J. Juilfs (translated by Arnold J. Pomerans from *Physik der Gegenwart*, Athenaüm-Verlag, 1952). Braziller, New York, 1957. 158 pp. $3.75.

Solvent Extraction in Analytical Chemistry. George H. Morrison and Henry Freiser. Wiley, New York; Chapman & Hall, London, 1957. 280 pp. $6.75.

Anthropology and Human Nature. M. F. Ashley Montagu. Porter Sargent, Boston, 1957. 400 pp. $6.

The Beginnings of Embryonic Development. A symposium organized by the Section on Zoological Sciences of the American Association for the Advancement of Science, cosponsored by the American Society of Zoologists and the Association of Southeastern Biologists, and presented at the Atlanta meeting, 27 Dec. 1955. Publ. No. 48. Albert Tyler, R. C. von Borstel, Charles B. Metz, Eds. American Association for the Advancement of Science, Washington, D.C., 1957. 400 pp. $8.75; $7.50 (members).

Biochemical Contributions to Endocrinology. Experiments in hormonal research. The Lane Medical lectures, 1956. Sir Charles Dodds. Stanford University Press, Stanford, Calif.; Oxford University Press, London, 1957. 76 pp. Illus. $3.

Biochemistry of the Amino Acids. Alton Meister. Academic Press, New York, 1957, 498 pp. $10.

Canine Surgery. A text and reference work. Karl Mayer, J. V. Lacroix, H. Preston Hoskins, Eds. American Veterinary Publ., Evanston, Ill., 1957. 839 pp.

Chemie und Biochemie der Reduktone und Reduktonate. Hans von Euler and Bernd Eistert. Enke, Stuttgart, Germany, 1957. 355 pp. DM. 47.40.

Détermination Pratique des Fossiles. André Chavan and André Cailleux. Masson, Paris, 1957. 387 pp. F. 5800.

Foot Troubles. T. T. Stamm. Philosophical Library, New York, 1957. 122 pp. $4.75.

Introduction à L'Etudes des Roches Métamorphiques et des Gites Métallifères. Physico-chimie et thermodynamique. Pierre Laffitte. Masson, Paris, 1957. 358 pp. F. 4000.

L'Analyse Qualitative et les Réactions en Solution. G. Charlot. Masson, Paris, ed. 4, 1957. 379 pp. F. 3600.

Personal Problems and Psychological Frontiers. A Cooper Union forum. Johnson E. Fairchild, Ed. Sheridan House, New York, 1957. 320 pp. $4.

Psychology in the Soviet Union. Translated by J. and M. Ellis, H. Milne, J. McLeish, N. Parsons, and others. Brian Simon, Ed. Stanford University Press, Stanford, Calif., 1957. 313 pp. $6.

Ultrastructure and Cellular Chemistry of Neural Tissue, vol. II of *Progress in Neurobiology.* Heinrich Waelsch, Ed. Hoeber-Harper, New York, 1957. 264 pp. $7.50.

Documentation and Information Retrieval. An introduction to basic principles and cost analysis. J. W. Perry and Allen Kent. Western University Press, Interscience, New York, 1957. 168 pp. $5.

Elements of Color in Professional Motion Pictures. Wilton R. Holm, Chair. Society of Motion Pictures and Television Engineers, New York, 1957. 104 pp.

Engineering Properties and Applications of Plastics. Gilbert F. Kinney. Wiley, New York; Chapman & Hall, London, 1957. 285 pp. $6.75.

The Galactic Novae. Cecilia Payne-Gaposchkin. North-Holland, Amsterdam; Interscience, New York, 1957. 336 pp. $8.50.

Teaching Science in the Secondary School. R. Will Burnett. Rinehart, New York, 1957. 394 pp. $5.25.

You Can Win a Scholarship. Samuel C. Brownstein, Mitchel Weiner, Stanley H. Kaplan. Barron's Educational Series, Great Neck, N. Y., 1956. 434 pp. Paper, $2.98.

Understanding Arithmetic. Robert L. Swain. Rinehart, New York, 1957 (first published, 1952). 285 pp. $4.75.

Virus in the Cell. J. Gordon Cook. Dial Press, New York, 1957. 208 pp. $3.

We Live by the Sun. J. Gordon Cook. Dial Press, New York, 1957. 192 pp. $3.

Fasteners Handbook. Julius Soled. Reinhold, New York; Chapman & Hall, London. 1957. 439 pp. $12.50.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, *but to the publisher or agency sponsoring the publication.)*

Pest Infestation Research, 1956. Report of the Pest Infestation Research Board with the report of the director of pest infestation research. Department of Scientific and Industrial Research. H.M. Stationery Office, London, 1957 (order from British Information Services, 45 Rockefeller Plaza, New York). $0.86.

Liquid Metals Technology, pt. 1. Chemical Engineering Progress Symposium series, vol. 53, No. 20. F. J. Van Antwerpen, Ed. American Institute of Chemical Engineers, New York, 1957. 84 pp.

The Rio Grande Flood. A comparative study of border communities in disaster. Disaster Study No. 7. Publ. 458. Roy A. Clifford. 145 pp. Paper, $2.50. *An Introduction to Methodological Problems of Field Studies in Disasters.* A special report prepared for the Committee on Disaster Studies. Disaster Study No. 8. Publ. 465. Lewis M. Killian. 35 pp. Paper, $0.75. *Convergence Behavior in Disasters.* A problem in social control. Disaster Study No. 9. Publ. 476. Charles E. Fritz and J. H. Mathewson. 102 pp. $2. National Academy of Sciences–National Research Council, Washington 25, D.C., 1957.

Strengthening Science Education for Youth and Industry. Proceedings of the seventh Thomas Alva Edison Foundation Institute, 19–20 Nov. 1956. New York University Press, N.Y., 1957. 162 pp. $5.

Travaux de l'Association Internationale de Géodésie, vol. 19. Rapports généraux. Etablis à l'occasion de la dixième assemblée général, Rome, 14–25 Sept. 1954. Pierre Tardi, Ed. Association Internationale de Géodésie, Paris, 1956. 10 repts.

World Directory of Crystallographers. Philips Laboratories contribution No. 115. Compiled by William Parrish. Philips Laboratories, Irvington-on-Hudson, N.Y., 1957 (order from Polycrystal Book Service, Brooklyn 1, N.Y.). 79 pp. $1.50.

Role of Hospitals in Programmes of Community Health Protection. First report of the Expert Committee on Organization of Medical Care. WHO Technical Rept. series, No. 122. World Health Organization, Geneva, 1957 (order from Columbia University Press, New York). 34 pp. $0.30.

Meetings and Societies

Nobel Laureates at Lindau

The seventh annual meeting of the Nobel laureates at Lindau, Bavaria, took place on 1–5 July. The idea for these meetings was conceived by two Lindau physicians, in 1950. They felt that the German doctors, who were isolated for many years, should be given a chance to come into personal contact with some of the leading scientists of the world. For this reason the Nobel laureates in medicine were invited as the guests of the city of Lindau, to lecture on their particular subjects. The first meeting proved to be such a fine success and so highly satisfactory, both to those who came to lecture and to those who came to listen, that it was decided to make these meetings an annual affair and to invite, in turn, the laureates of medicine, chemistry, and physics. The city of Lindau and Count Bernadotte (nephew of King Gustav of Sweden, a patron of the meetings) act as hosts.

In the course of time, the emphasis changed to some degree from the original purpose. The Nobel laureates came to value the opportunity to meet personally and to discuss their problems in informal surroundings. Scientists who knew one another's work well and who had often corresponded with one another found here the chance to become personally acquainted. One result of this personal contact was demonstrated in 1955 at the fifth meeting—the second conference of the Nobel laureates of chemistry—when the famous resolution against the use of atomic energy for destructive purposes was formulated and signed in Lindau. It was made public at the traditional closing meeting on Count Bernadotte's Island of Mainau.

A large number of instructors, assistants from various scientific institutions, and graduate students in German and foreign universities are invited to attend these meetings. Financial assistance obtained from various German industrial concerns makes these meetings possible. The city of Lindau (23,000 inhabitants), situated on an island in Lake Constance, has come to look upon the costs of these meetings as its contribution to the advancement of science and a recognition of the fact that it came through the war unscathed. Count Bernadotte contributes greatly, both through personal contacts and by invitations to his castle, to the success of these meetings.

The following program was arranged for the 1957 meetings: P. S. Hench, (Rochester, Minn., U.S.A.), "The chemical and experimental uses of cortisone"; Werner Forssmann (Bad Kreuznach, Germany), "Die Bedeutung der selektiven Lungen-Angiographie und der Herzkatheterung für die Klinik der Herz- und Lungenkrankheiten"; W. M. Stanley (Berkeley, Calif., U.S.A.), "Relations between viruses and cancer"; Georg von Hevesy (Stockholm, Sweden), "Krebsanämie"; Gerhard Domagk (Wuppertal-Elberfeld, Germany), "Stand der Chemotherapie des Carcinoms"; Selman A. Waksman (New Brunswick, N.J., U.S.A.), "Antibiotics and their social significance"; Paul Hermann Müller (Basel, Switzerland), "Antibiotica in der Landwirtschaft."

Two days were devoted to excursions to the mountains and on the lake. Count and Countess Bernadotte received the group at their castle on Mainau; other social activities included a reception, a banquet, a student affair, and a ballet performance.

Some 150 students, assistants, and professors from various East and West German universities attended the meetings. Among the other Nobel prize winners attending were Kurt Alder of Cologne, Max Born of Bad Pyrmont, and Otto Hahn of Göttingen.

SELMAN A. WAKSMAN
Institute of Microbiology,
Rutgers, State University,
New Brunswick, New Jersey

Some of the participants in the 1957 Lindau conference: (front row, left to right) W. M. Stanley (California), P. S. Hench (Rochester), Georg von Hevesy (Stockholm), Count Graf Bernadotte, S. A. Waksman (Rutgers), and Kurt Adler (Cologne).

International Conference on Citrus Virus Diseases

An international conference on citrus virus diseases will be held 18–22 Nov. on the Riverside campus of the University of California. J. M. Wallace, plant pathologist, is in charge of arrangements for the conference, which is part of the 50th anniversary celebration of the university's Citrus Experiment Station.

Recent findings in the study of plant viruses, as well as efforts to control those diseases attacking citrus, will be reported by virus experts from the major citrus-producing areas of the world. Diseases to be discussed include psorosis, tristeza (quick decline), seedling yellows, exocortis, cachexia, and zyloporosis. Also outlined will be a screening program to permit the introduction for experimental trials of new citrus varieties from foreign sources without danger of introducing new virus diseases and a certification program for insuring virus-free nursery stock.

Estrogens

The Worcester Foundation for Experimental Biology in Shrewsbury, Mass., was host to 25 researchers at a conference 22–24 Aug. to evaluate methods of determining estrogens in body fluids and tissues. The meeting was under the aus-

pices of the American Cancer Society, with Gregory Pincus of the Worcester Foundation as chairman. The agenda included a review of the principal findings and recommendations of the British Empire Cancer Campaign Conference; the role of estrogens and estrogen metabolites in urine; the extraction and preliminary purification of estrogens and their metabolites; the determination of urinary estrogens; estrogens of blood and tissues; and arrangements for collaborative investigation.

Among those present were the following visitors from abroad: Guy F. Marrian (University of Edinburgh), Egon Diczfalusy (Karolinska Institute, Stockholm), A. E. Kellie (Courtauld Institute of Biochemistry, London), J. R. K. Preedy (Medical Unit, London Hospital), R. D. H. Heard (McGill University), and William Bauld (Montreal General Hospital, Montreal).

Analytic Chemistry in Reactor Technology

The Oak Ridge National Laboratory is inaugurating an annual series of unclassified meetings on the role of analytic chemistry in nuclear reactor technology. The first meeting, which will be devoted to "The analyses of nuclear reactor materials," is to be held in Gatlinburg, Tenn. For further information, contact D. D. Cowen, Director of Public Relations, Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tenn.

IBM-704 for Crystal Structure

A conference on the use of the IBM-704 computer for crystal-structure analysis will be held at the National Bureau of Standards in Washington, D.C., 4–5 Nov. This conference is being sponsored jointly by NBS and the American Crystallographic Association. For further information write to the program chairman, Prof. Vladimir Vand, Pennsylvania State University, University Park, Pa.

Physiological Congress

Preparations for the 21st International Physiological Congress, to be held in Buenos Aires, Argentina, 9–15 Aug. 1959, are proceeding actively under the leadership of Bernardo Houssay, who will be president of the congress. This is the first such meeting to be held in the Southern Hemisphere.

Financial support for the considerable expenses of the undertaking are being sought from various sources, including the drug manufacturers of North America, who have generously supported previous congresses. Contributions have already been received from Burroughs Wellcome and Company, Inc., Ciba Pharmaceutical Products, Inc., Hoffmann-La Roche, Inc., Eli Lilly and Company, Merck and Company, Inc., Merrell-National (Overseas) Laboratories, Olin Mathieson International Corporation and the Squibb Institute for Medical Research, and the Upjohn Company.

Forthcoming Events

October

6–10. Electrochemical Soc., fall, Buffalo, N.Y. (H. B. Linford, 1860 Broadway, New York 23.)

7–9. National Electronics Conf., Chicago, Ill. (J. S. Powers. NEC, 84 E. Randolph St., Chicago 1.)

7–11. American Inst. of Electrical Engineers, fall general, Chicago, Ill. (N. S. Hibshman, AIEE, 33 W. 39 St., New York 18.)

7–11. Research Contributions to Clinical Practice, New York Acad. of Medicine Postgraduate Week, New York. (Secretary, Postgraduate Week, New York Acad. of Medicine, 2 E. 103 St., New York 29.)

8–10. International Assoc. of Milk and Food Sanitarians, annual, Louisville, Ky. (H. H. Wilkowske, Dairy Science Dept., Univ. of Florida, Gainesville.)

8–10. Upper Air Conf., American Meteorological Soc., Omaha, Nebr. (K. C. Spengler, AMS, 3 Joy St., Boston 8, Mass.)

9–11. High Vacuum Technology, 4th annual symp., Boston, Mass. (Committee on Vacuum Techniques, P.O. Box 1282, Boston 9.)

9–11. Society for Experimental Stress Analysis, fall, San Diego, Calif. (W. M. Murray, SESA, P.O. Box 168, Cambridge 39, Mass.)

9–12. Audio Engineering Soc., annual, New York. (S. M. Fairchild, AES, 17 E. 65 St., New York 21.)

9–12. Tau Beta Pi Assoc., annual, Madison and Milwaukee, Wis. (R. H. Nagel, Univ. of Tennessee, Knoxville.)

10–11. Noise Abatement Symp., 8th annual, Chicago, Ill. (J. J. Kowal, Armour Research Foundation, 10 W. 35 St., Chicago 16.)

10–13. Angiology, 3rd internatl. cong., Atlantic City, N.J. (H. Haimovici, 105 E. 90 St., New York 28.)

11–13. Iroquois Research, 11th conf., Red House, N.Y. (W. N. Fenton, New York State Museum, Albany 1.)

12. Fat and Diabetes Symposium, New York, N.Y. (T. Kingsley, New York Diabetes Assoc., 104 E. 40 St., New York 16.)

13–18. American Acad. of Ophthalmology and Otolaryngology, annual, Chicago, Ill. (W. L. Benedict, 100 First Avenue Bldg., Rochester, Minn.)

14–16. Association of Official Agricultural Chemists, 71st annual, Washington, D.C. (W. Horwitz, Box 540, Benjamin Franklin Station, Washington 4.)

14–18. American College of Surgeons, 43rd annual clinical cong., Atlantic City, N.J. (ACS, 40 E. Erie St., Chicago 11, Ill.)

14–18. American Soc. of Civil Engineers, New York, N.Y. (W. H. Wisely, ASCE, 33 W. 39 St., New York 18.)

14–18. International Industrial Development Conf., San Francisco, Calif. (E. S. Prentice, Stanford Research Inst., Menlo Park, Calif.)

16–23. Enzyme Chemistry, internatl. symp., Tokyo and Kyoto, Japan. (International Symp. on Enzyme Chemistry, Science Council of Japan, Ueno Park, Tokyo.)

17–18. American Ceramic Soc., 10th Pacific Coast mtg., San Francisco, Calif. (C. E. Pearce, ACS, 4055 N. High St., Columbus 14, Ohio.)

17–18. Industrial Hydraulics, natl. conf., Chicago, Ill. (Conference Secretary, Armour Research Foundation, 10 W. 35 St., Chicago 16.)

17–19. Indiana Acad. of Science, Greencastle. (H. Crull, Dept. of Mathematics, Butler Univ., Indianapolis 7, Ind.)

17–19. Optical Soc. of America, Columbus, Ohio. (S. S. Ballard, Visibility Lab., Scripps Institution of Oceanography, San Diego 52, Calif.)

18–19. National Soc. of Professional Engineers, Bismark, N.D. (P. H. Robbins, 2029 K St., NW, Washington 6.)

19. American Acad. of Psychotherapists, 2nd annual, New York. (G. Dolger, 11 Riverside Dr., New York 23.)

19–26. Social Work, 3rd Pan American cong., San Juan, Puerto Rico. (A. Porrata Dorla, Apartado 3271, San Juan.)

20–22. American College of Apothecaries, St. Louis, Mo. (R. E. Abrams, Hamilton Court, Chestnut and 39 St., Philadelphia, Pa.)

20–27. International Soc. of Surgery, 17th cong., Mexico, D.F., Mexico. (P. Martin, ISS, 141, rue Belliard, Brussels, Belgium.)

21. Air Pollution Symp., 2nd annual, Philadelphia, Pa. (A. D. Hollingsworth, Franklin Inst., Benjamin Franklin Parkway at 20th, Philadelphia 3.)

21–25. Medical Aspects of Workmen's Compensation, New York. (Office of Associate Dean, New York Univ. Post-Graduate Medical School, 550 First Ave., New York 16.)

21–26. Ultra High Frequency Circuits and Antennas, internatl. conf., Paris, France. (Congrès Circuits et Antennes Hyperfréquences, Société des Radioélectriciens, 10, Avenue Pierre-Larousse, Malakoff (Seine), France.)

22. American Soc. of Safety Engineers, annual, Chicago, Ill. (J. B. Johnson, ASSE, 425 N. Michigan Ave., Chicago 11.)

22–25. American Dietetic Assoc., annual, Miami, Fla. (Miss R. M. Yakel, ADA, 620 N. Michigan Ave., Chicago 11, Ill.)

23–25. American Soc. of Body Engineers, Detroit, Mich. (E. W. Lange, ASBE, 100 Farnsworth, Detroit 2.)

24–25. Computer Applications Symp., Chicago, Ill. (Conference Secretary, Armour Research Foundation, 10 W. 35 St., Chicago 16.)

24–25. Engineers General Assembly, New York, N.Y. (Engineers Joint Council, 29 W. 39 St., New York 18.)

(See issue of 16 August for comprehensive list)

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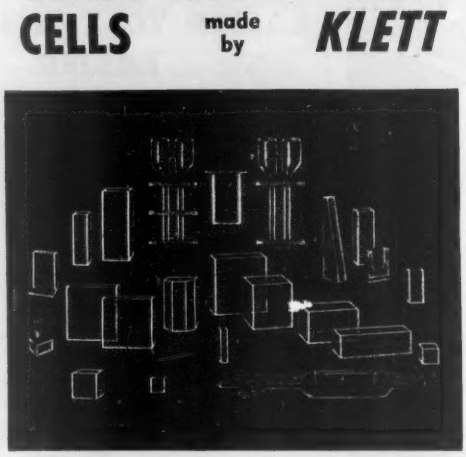

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LETTERS

The editors take no responsibility for the content of the letters published in this section. Anonymous letters will not be considered. Letters intended for publication should be typewritten double-spaced and submitted in duplicate. A letter writer should indicate clearly whether or not his letter is submitted for publication. For additional information, see Science **124**, *249 (1956) and* **125**, *16 (4 Jan. 1957).*

Russian Scientific Information

The importance of keeping abreast of Russian scientific information cannot be questioned, and the article by Ralph E. O'Dette, "Russian translation" [*Science* **125**, 579 (1957)], emphasizing this point was very informative indeed. However, O'Dette's plans for translating complete U.S.S.R. journals seem to me to be too costly and unnecessary in the light of certain facts not mentioned in the article.

Most U.S.S.R. journals have English tables of contents, and several have good English summaries—for example, the journal *Voprosy Virusologii* (*Problems in Virusology*), six issues a year, one issue 60 to 65 pages. The first issue of 1957 contains about 1500 English words (!), and the annual subscription rate is $2. Several other U.S.S.R. journals have similar English contents and summaries—for example, Leningrad University series: *Fiziki i Khimii, Mikrobiologia, Antibiotiki, Voprosy Meditsinskii Khimii, Patologicheskaia Fiziologia i Experimentalnaia Terapia,* and so on. Furthermore, there seems to be a trend toward more journals' doing likewise, probably to encourage circulation in English-speaking countries. To completely translate these journals—that is, by National Institutes of Health-awarded contracts, would be time consuming, and the cost would be extremely high, especially when one considers the diluted quality of the work coming out of the U.S.S.R.

It seems to me that contents lists and summaries are usually informative enough. Where the translation of a complete article is desired, existing translating agencies, government and commercial, can do this without undue delay and, in the long run, at less cost for all concerned.

HEINO A. LUTS

Esto Associates,
New Providence, New Jersey

Heino Luts' point is, of course, a sound one, and it is one which we try to keep constantly in mind in planning. We are aware of about 85 Russian journals that presently carry English titles, abstracts, or both. This is a much better situation than existed a year or two, or even 6 months, ago.

Complete translation of a Russian journal is "economical," in the strictest sense, only if enough of the journal is of sufficient interest to enough scientists to sustain a subscription list to the translation, thus reducing or eliminating (it is hoped!) government subsidy.

The prices of government-subsidized translated journals are such that a year's subscription is about equal to the commercial cost of translating, to order, one or two average papers. By trying to select only the very best Russian journals, the professional societies with whom we work hope to prejudice the odds in favor of a researcher's wanting more than one or two papers translated in full during a year.

There should be the widest possible awareness of the English-language information published by the Russians. This simplifies our problem to some extent, but English titles or abstracts of Russian papers serve the same purpose as English titles or abstracts of English papers. An abstract or a title is sufficient only if it is enough. If one wishes to read an entire Russian paper and does not read the language, one must generally obtain a translation.

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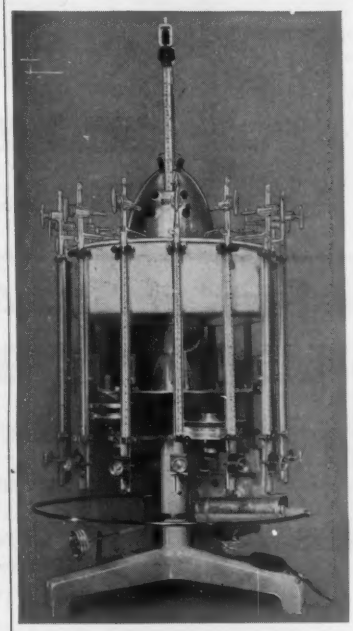

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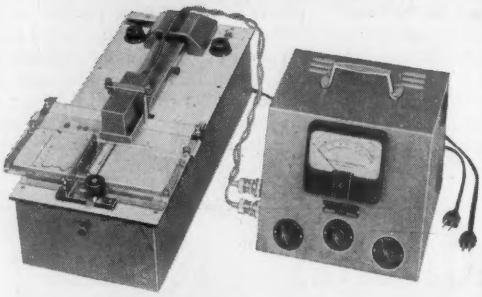

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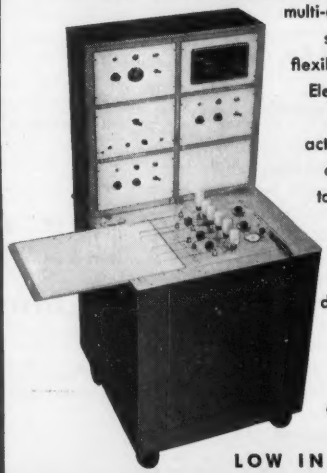

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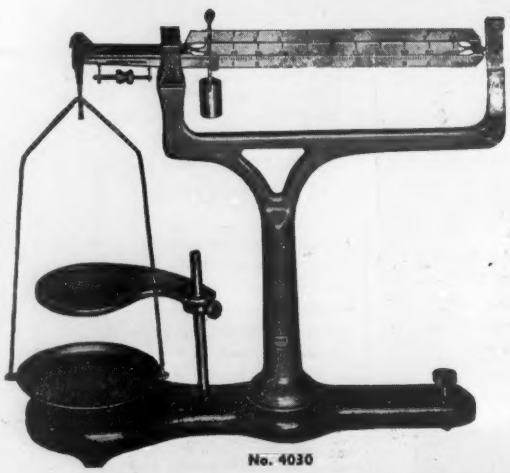

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RALPH E. O'DETTE
National Science Foundation, Washington, D.C.

Transabdominal Amniocentesis

I should like to point out a problem in ethics involved in a recent paper by Parrish, Lock, and Rountree [*Science* **126**, 77 (1957)]. The authors report on 50 cases of transabdominal amniocentesis in normal pregnant women. Mention should be made of the disregard of patients involved in trying this procedure on these cases in view of the high incidence of congenital abnormalities following amniocentesis in mice reported by Trasler *et al.* [*Science* **124**, 439 (1956)]. Although no fetal trauma was reported, this was an experiment, and the result might have come out the other way. Were the patients aware of the dangers?

LUCILLE MOROWITZ
559 Avon Drive, Orange, Connecticut

In response to Lucille Morowitz, who questioned the ethics involved in our performing transabdominal amniocentesis in normal pregnant human beings [*Science* **126**, 77 (1957)] after Trasler *et al.* [*Science* **124**, 439 (1956)] had reported congenital malformations in mice following a similar procedure, we would like to offer the following considerations.

First, Rivett [*Am. J. Obstet. Gynecol.* **52**, 890 (1946)] did not observe amniocentesis harmful to the mother or child in 50 human cases of polyhydramnios, nor did Dieckmann and Davis [*Am. J. Obstet. Gynecol.* **25**, 623 (1933)] note any deleterious effects produced by the procedure in 25 normal human patients. Second, our work was completed during 1955, before the publication of Trasler's report. Also, Trasler's work was done on mice, which have two uterine horns accustomed to multiple pregnancy, in contrast to the single uterine segment of human beings in which a single pregnancy usually develops. Perhaps here we have an example of the inapplicability of the results of animal experiments to the results obtained in human beings. Third, the nature of the test was explained carefully to each patient, after which written permission was obtained to perform the test.

Reports in the literature and our own results do not seem to indicate that transabdominal amniocentesis is a dangerous operation in human beings; however, further evaluation is necessary before the procedure can be recommended for general use.

HENRY M. PARRISH
FRANK R. LOCK
MARY E. ROUNTREE
Department of Obstetrics and Gynecology, Bowman Gray School of Medicine of Wake Forest College, Winston-Salem, North Carolina

EQUIPMENT NEWS

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■ TRANSISTORIZED CONVERTER is designed for input of 24 to 28 v d-c and input current of 2.3 amp. Output is 270 v d-c at 150 ma. Voltage regulation between 15 and 150 ma is better than 85 percent. Ripple is 0.03 percent. Temperature rise is 10°C at 150 ma. Weight is 3 lb. (Aircraft Radio Corp., Dept. S496)

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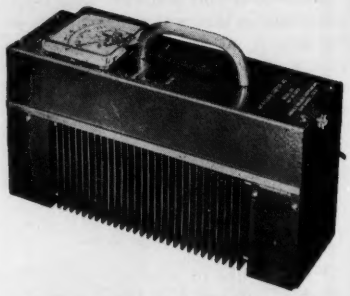

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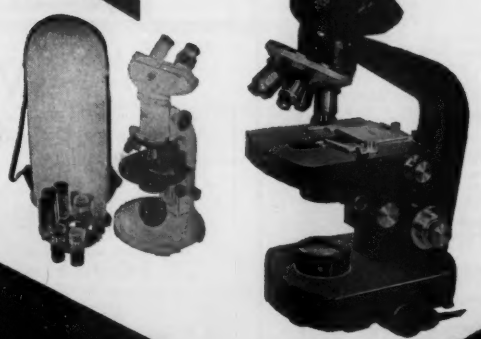

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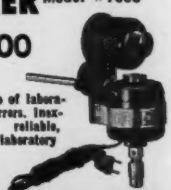

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APPLICATION FOR HOTEL RESERVATIONS

124th AAAS MEETING

Indianapolis, December 26-30, 1957

The list of hotels and their rates and the reservation coupon below are for your convenience in making your hotel room reservation in Indianapolis. Please send your application, *not* to any hotel directly, but to the AAAS Housing Bureau in Indianapolis and thereby avoid delay and confusion. (Exception: Members of the American Astronomical Society who wish reservations at the Marott Hotel, 2625 North Meridian Street, are asked to correspond directly with that hotel.) The experienced Housing Bureau will make assignments promptly; a confirmation will be sent you in two weeks or less.

As in any city, single-bedded rooms may become scarce; double rooms for single occupancy cost more; for a lower rate, share a twin-bedded room with a colleague. Most hotels will place comfortable rollaway beds in rooms or suites at 2.50 to 3.00 per night. Mail your application *now* to secure your first choice of desired accommodations. All requests for reservations must give a definite date and estimated hour of arrival, and also probable date of departure.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Rates for Rooms with Bath

All hotels have sessions in their public rooms. For a list of headquarters of each participating society and section, please see *Science,* July 19, or *The Scientific Monthly* for August.

Hotel	Single	Double Bed	Twin Bed	Suite
Antlers	$4.50–10.00	$7.00–12.00	$10.50–12.00	$14.50–19.50
Claypool	7.00–10.00	9.50–14.00	10.50–14.00	13.50–34.00
Continental	8.00–10.00	8.00–12.00	8.00–12.00	12.00–15.00
Marott	7.00–14.50	9.00–14.50	10.00–17.50	14.50 and up
Severin	6.00– 9.00	8.50–12.50	11.00–15.00	25.00
Sheraton-Lincoln	6.50–11.50	9.85–15.00	13.35–16.00	24.35 and up
Warren	6.50–10.50	8.50–12.50	12.00–13.00	25.00–35.00
Washington	5.50–10.00	7.00–11.00	11.50–16.00	18.00–45.00

THIS IS YOUR HOUSING RESERVATION COUPON

AAAS Housing Bureau
1201 Roosevelt Building
Indianapolis 4, Ind.

Date of Application .....

Please reserve the following accommodations for the 124th Meeting of the AAAS in Indianapolis, Dec. 26–30, 1957:

TYPE OF ACCOMMODATION DESIRED

Single Room ..... Desired Rate ..... Maximum Rate .....

Double-Bedded Room ..... Desired Rate ..... Maximum Rate ..... Number in party .....

Twin-Bedded Room ..... Desired Rate ..... Maximum Rate .....

Suite ..... Desired Rate ..... Maximum Rate ..... Sharing this room will be:

(Attach list if this space is insufficient. The name and address of each person, including yourself, must be listed.)

.....

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First Choice Hotel ..... **Second Choice Hotel** ..... **Third Choice Hotel** .....

DATE OF ARRIVAL ..... DEPARTURE DATE .....
(These must be indicated—add approximate hour, a.m. or p.m.)

NAME .....
(Individual requesting reservation) (Please print or type)

ADDRESS .....
(Street) (City and Zone) (State)

***Mail this now to the Housing Bureau.* Rooms will be assigned and confirmed in order of receipt of reservation.**

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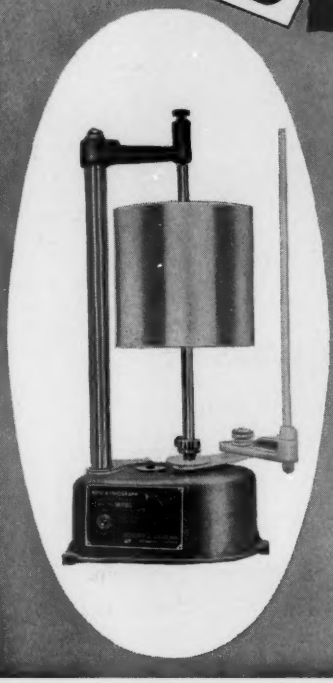

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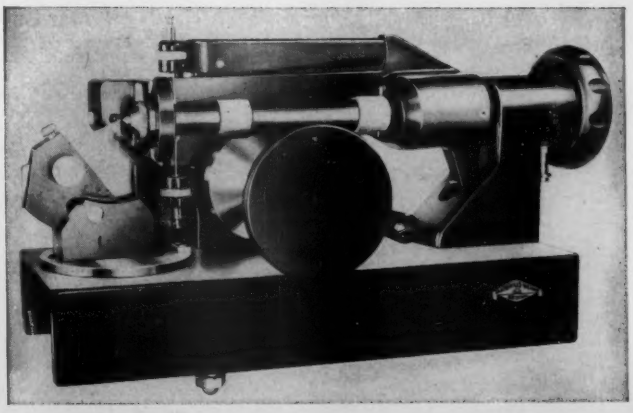

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